JPRS-EST-93-013
1 April 1993

FOREIGN BROADCAST INFORMATION SERVICE

JPRS Report

Science & Technology

Europe/International

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

Science & Technology
Europe/International

JPRS-EST-93-013 *1 April 1993*

CONTENTS

ENERGY, ENVIRONMENT

FACTORY AUTOMATION, ROBOTICS

NUCLEAR R&D

SUPERCONDUCTIVITY

TELECOMMUNICATIONS

INTERNATIONAL

SCIENCE & TECHNOLOGY POLICY

EUROPE-ASIA RELATIONS

ADVANCED MATERIALS

German Research in Nanocrystalline Ceramics Noted

93WS0271A Stuttgart BILD DER WISSENSCHAFT in German Feb 93 pp 85-89

[Article by Dr. Barbara Wantzen, a physicist employed as a free-lance journalist in Ulm and whose special field is material research: "Nanotechnology: Small, but Minute"—first paragraph is BILD DER WISSENSCHAFT introduction]

[Excerpts]

New Kinds of Materials Out of Miniature Crystals

Material researchers have rung in a new era. Ductile ceramics and hitherto "impossible" alloys grow out of tiny crystals consisting of only a couple of layers of atoms. [passage omitted]

Crystals consist of thousands of atoms which, row on row, plane on plane, are assembled into a lattice. On the other hand, at the boundaries between crystals atoms hop about like ping-pong balls at enormous speeds from one spot to another. It seems as if they did not know to which crystal they belong.

Because of this, the density of the material at the boundaries between crystals is clearly lower than the density of the crystal. Moreover: "The densities measured are far lower than the density of liquids and are comparable to those of gases at pressures of 500 to 1,000 bars. This sounds so improbable that no one wanted to believe us when we began our research," Prof. Herbert Gleiter of the Institute for New Materials in Saarbruecken said.

He is the father of the nanos. He and his colleagues discovered these materials in the early 1980s. "We pursue basic research and, because we want to learn more about the structure of crystal boundaries, we have made crystals ever smaller and, as a result, the proportion of crystal boundaries has increased. We knew that crystal boundaries considerably influence the properties of the materials. But we ourselves were surprised at such extreme changes."

Then chance took a hand in the matter. As the researchers were trying to compress titanium dioxide powder into a microchip, it broke apart. When they compressed it a second time—to their great surprise—one again they obtained an undamaged molded chip. This dicovery revealed that, under certain conditions, ceramics too are malleable or—as it is referred to in the technical jargon—ductile.

Many scientists are now working feverishly all over the world on developing nanos. The interest in them is so great that there is even a journal in the U.S. that is devoted to the subject. And there are already start-up companies there that are exclusively devoted to the marketing of nanocrystalline ceramics.

Companies are trying to make money with nanotechnology not only in the U.S. In Germany, too, the first products are being offered for sale. Thus, since 1992, Hanau Vacuum Melt has been selling wound magnetic cores made of nanocrystalline iron alloys of the kind used for magnetic head coils or high-frequency transformers.

Their experience in the production of amorphous, that is, noncrystalline, metals was useful to the people in Hanau in developing marketable products. They are produced by rapid congealing of the melt in the process of which the disordered state of the melt is frozen into the material. When these amorphous metals are heated to a given temperature, a nanocrystalline material is produced after a while.

Up to now, the people in Hanau have produced their magnetic cores from expensive amorphous cobalt alloys. These are distinguished from others by the fact that they change their direction of polarization in magnetic fields that are as much as 100 times smaller than the earth's. The new nanocrystalline iron alloys now have not only in part better magnetic properties. They are also cheaper than noncrystalline cobalt alloys. They are also working on nanotechnology in Bremen. Collaborators at the Fraunhofer Institute for Applied Research on Materials are vaporizing pure metals and ceramics in special ovens. In this way they can produce nanocrystalline powder from basic precious metals—like, for example, silver. But nearly another 10 years will probably go by before such products can be used in industrial production, according to Fraunhofer researchers' estimates.

Before then, nanocrystalline ceramics alone could become a big seller. Ceramics—more of a dry concept for laymen—makes engineers' eyes light up. Because this material has many properties that are expected of modern materials: Ceramics are hard, wear-resistant, and even extremely high temperatures can hardly harm them. So ceramics would be the ideal material for the production of engines and turbines—if they did not break up so quickly. This is why armies of material researchers have been looking for years now for a way of making ceramics bend to their will. Nanocrystalline ceramics are an odds-on favorite for the solution to this problem.

Normal-sized crystals have lattice defects. In them atoms just do not sit lined up in their lattice positions as hens do on their roost. Every now and then a position is left open or an atom gets squeezed in somewhere between other atoms. But entire lattice planes may also be shifted up against one another. Since normal crystals consist of a big lattice, these defects can spread through the crystal until they get stuck somewhere inside it. The wandering lattice defects are the real reason why metal is so malleable. This is so only because the atoms are not so firmly bound to one another.

In conventional ceramics the ion bond holds the atoms together so tightly that the lattice defects cannot wander at low temperatures. This is why ceramics are hard and brittle. The lattice defects have to be properly heated first before they are set in motion at temperatures far greater than 1,000° C. Ceramics cannot, of course, be worked like a piece of metal that can be rolled into a sheet at these temperatures either. With nanos, on the other hand, the individual crystals can set themselves in motion against one another even at room temperature. Experts say that they can slide against one another. This makes nanocrystalline ceramics malleable. In any case, this is how many scientists today think the nanoceramic deformation process works. "But we still do not completely understand how they become malleable under pressure. It is not yet even fully certain that these ideas about it are really correct," Professor Gleiter commented on this hypothesis.

The structure of the nanos opens even more striking possibilities: In this way alloys are produced from metallic elements which, according to current text-book knowledge, should never bond with one another—for example, between iron and

silver. "Ordinarily, there should be equally as many iron and silver atoms at the crystal boundaries. But we found that iron atoms migrated into the peripheral zones of the silver crystals and silver atoms settled in the iron crystals. Thus, a real alloy was formed," Gleiter commented on his tests. He explains this effect in this way: "We think that the crystal lattice of the silver and iron crystals in the peripheral zones is distorted. Thus, it is expanded or compressed. The bigger silver atoms find room for themselves in the expanded iron-crystal lattice and in the compressed spots of the silver crystal the big atoms move away, thus making room for the smaller iron atoms. This is how the distortions of the lattice are evened out and the tensions reduced."

What is possible with two metals that normally do not tolerate one another could perhaps also apply to ceramics and metals. The Krupp Research Institute has picked up on this idea and developed metal-ceramic bonds.

Even high-temperature ceramic superconductors, brittle by nature, might possibly be shaped into flexible wires in a nanostate. To be sure, the necessary production methods for this have not matured and it will take some time before products turned out by nanoworkshops can be introduced into everyday life. But meanwhile, many industrial researchers attentively listen when the buzzword, nanocrystalline materials, is mentioned.

The discoverer of nanos, Herbert Gleiter, now does not run into sheer incomprehension any more, as he did 10 years ago.

[Box, p 88]

The Nanomiller

In a small, inconspicuous room there are four mills that produce tiny nanocrystals. Material scientists go into raptures about these products. Among them are Wolfgang Schlump and his colleagues. Especially nanocrystalline ceramic-metal alloys, whose resistance to wear overshadows most materials in use to date, have made quite an impression on him. At Krupp, his employer, they use such materials for the processing of metals and plastics—that is, for tools on which extreme demands are placed.

"We produce the nanocrystalline ceramic-metal alloys by high-energy grinding," Schlump, the director of the Materials and Components Department at the Krupp Research Institute in Essen, told us. Of course, only about 1.5 kg of nanos per load can be produced in the institute's high-energy mills—or attritors, as they are called in the technical jargon. The ingredients: wolfram carbide and vanadium powder, lampblack, and cobalt powder. Further added to these are 25 kg of steel balls that serve as grinders.

During grinding, the powder particles, from 50 to 100 micrometers in size, get between the steel balls again and again. The metal particles, that is, the vanadium and cobalt particles, are rolled flat. The ceramic particles, composed of wolfram carbide and lampblack—in other words, carbon—shatter against the balls.

If ceramic and metal particles get between the balls at the same time, they are squeezed on top of one another and rubbed against one another. In the process, their surfaces heat up so much that the atoms are set in motion. they jump from the surface of one particle to the surface of another one.

There they remain attached: The powder particles bake together. The experts call this process cold or friction welding. This results in an elongated particle that combines ceramic and metal components in itself. If the particles get between two balls again, accretions take place again. Through this process, the crystals, which are composed of the powder particles, become elongated and lamellate. The more frequently the powder particles go through such a process, the smaller the crystals become. In the process, the powder particles get harder and more brittle. However, it takes several days for them to reach the desired size of a few nanometers.

One advantage of this method is the comparatively simple further processing of the material—since powder is not explosive. This is not the case with the sol-gel method or rare gas condensation. Since when these minute dimensions are involved, even otherwise harmless compounds often become concentrated charges: Particles 10 or 20 nanometers in size provide the oxygen in the air with a large surface to attack, in the process of which many materials oxidize in an explosive manner. They always have to be stored and processed in the presence of a protective gas—that is, in an oxygen-free atmosphere.

"We, on the other hand, can produce nanopowder with a conventional method—high-energy grinding—a powder that can be processed into powder metal in a conventional way," Schlump said. It is true that the powder particles produced by grinding consist of crystals only a few nanometers in size. But they are integrated into particles that are from 10 to several hundred micrometers big—that is, about a thousand times bigger than the nonoparticles and which therefore oxidize more slowly.

The researchers at Krupp are at the present time working on optimizing their nanopowder for vacuum plasma sprays. With this coating method, the powder is sprayed into a gas flame. In the process, the powder particles fuse with and blow cover the surface of the production part that is to be coated at high speed. Powder with particle sizes of about 45 micrometers are required for this coating method. "The particle size of our present powder is, to be sure, already distributed around this figure, but there are still too many particles that are smaller or larger," Schlump complained. And he confessed: "It will probably take a while before we have this under control."

France: New Microscope for Materials Analysis

93WS0274B Paris COMPOSITES ET NOUVEAUX MATERIAUX in French 19 Jan 93 pp 4, 5

[Article: "Microanalysis of Materials at LNE"]

[Text] The National Test Laboratory's [LNE's] scanning electron microscope is equipped with an EDS [energy-dispersive system] type of microanalysis capability, enabling a high degree of precision in the field of analysis and imagery. The advantage of this microanalysis technique over X-ray fluorescence techniques stems from the ability to localize zones or particles of very small dimensions (deposits of corrosion, welds, thin films, threads, etc...).

All types of materials, conductive or not, can be analyzed. A qualitative analysis can be made of all the elements in the periodic table except boron, and a quantitative analysis of all the elements except sodium.

For very small sized samples of conductive materials, up to 50 mm in diameter, these analyses are nondestructive. Using this technique, the LNE, as part of its mission of providing services, can characterize all types of materials.

Contact: Eric Van Balinghem, Tel:30 69 10 06.

AEROSPACE

Germany, Russia Sign Agreement on Space Cooperation

93P60167 Duesseldorf HANDELSBLATT in German 2 Mar 93 p 6

[Text] An agreement has been signed between the Federal Republic of Germany and Russia about further cooperation in space. It involves space research and using space for peaceful purposes.

During the signing by the general director of the German Space Agency (DARA), Wolfgang Wild, and the general director of the Russian space agency, Yuri Koptev, the FRG Minister of Research Matthias Wissmann said that on the basis of the decisions made by ESA (European Space Agency) last fall, German space policy will seek new perspectives and strategic approaches to "globalize" its space activities.

In Wissmann's opinion, the obligation to use resources economically will have the result that large scale projects can only be accomplished in international cooperation. In view of the rapprochement between East and West, prestige projects are no longer in keeping with the times, he said.

The new German-Russian agreement concerns the construction and flight of an unmanned space capsule called "Ekspress" which is able to return to earth. According to Wissmann, this capsule is of great importance for studying physical phenomena during the reentry of space vehicles into the atmosphere, as well as for carrying out microgravity experiments.

This project is simultaneously the first cooperation agreement between Germany and Japan in the field of space technology. The relevant project agreement between DARA and Japanese partners, including the Ministry of International Trade and Industry (MITI) was concluded in December 1992 in Bonn.

According to the agreed-upon division of tasks with the Russian and Japanese space partners, German industry, together with the Russian space enterprise KB Salyut, will manufacture the descent vehicle. Japan will launch the capsule with its own carrier rocket. German and Japanese scientists will jointly carry out the experiments during the flight.

The German Aerospace Research Institute (DLR) in Stuttgart, the Technical University of Braunschweig, and the University of Stuttgart are involved on the German side. The capsule is to be launched in 1994. After it operates for a week on automatic mode, it is supposed to parachute down in Australia. The German share of the costs for the project is about DM35 million. This project will rely on Russian experience with space capsules. Research Minister Wissmann says that the Ekspress project will provide a new dimension to cooperation with Russia. The high point of previous cooperation was the Mir 92 project, when the German cosmonaut Klaus Dieter Flade flew on the Mir spaceship. Last year DARA and the Russian Academy of Sciences already agreed on a revised program of space research and utilization. The focal point remains the international Mars 94 mission, which will be led by the Russians but have significant German participation. This program will continue the study of Mars, according to the Research Ministry in Bonn.

DARA has also announced that the German D-2 mission, which recently had to be postponed due to American rocket problems, will take place in mid-March.

Germany: Robot Developed for Astronauts on D-2 Space Mission

93WS0279A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 16 Feb 93 p 8

[Article by R.E.: "Extremely Precise Robot Helps Astronauts; for First Time, Experiments With Remote Control of Robots in Space"]

[Text] Frankfurt—If the German D-2 space mission takes place soon, the astronauts will also be able to experiment with a remarkable robot system. Astronaut Ulrich Walter can be seen in the above photo [not reproduced] during training with the Rotex (Robot Technology Experiment) robot arm. The robot system consists, on the one hand, of a technically demanding robot system in the D-2 spacelab and, on the other, of a multifunctional ground station in the German GSOC (German Space Operation Center) ground control center in Oberpfaffenhofen, near Munich. It is serving as a pilot project for an extensive automation project in space. The system was developed by Dornier (German Aerospace, Inc., (DASA) Munich).

As described by the company, the Rotex controls an extremely precise arm with six joints and a highly-developed gripping device. It carries out the most varied kinds of experiments in the tightest amount of space. For example, the arm puts together a tower structure out of three interlockable cubes. The same process will take place on a larger scale later during the construction of a space station.

A highly-developed electronic system supplies the Rotex with power, controls its movements, reads in readings, and transmits them to earth. The Rotex can be observed with a video camera from the ground station as it operates. The highpoint of the Rotex experiments will be the remote control from the ground station by means of graphic simulation alone of the readings and three-dimensional pictures sent to earth by the robot. This has never up to now been attempted in space.

The problem with this is the time required to transmit the data. A command from the ground station only reaches the robot after about three seconds. The readings that are sent back also require this much time. The most demanding experiment will be the remote-controlled capture of a cube that is slowly floating away from it. This is important since a space robot must be able to operate much more flexibly than an industrial robot with predetermined work points.

The Rotex is expected to provide proof that automation of specific tasks inside and outside of a space laboratory is possible. Along with Dornier, the DASA Product Division's Orbital Infrastructure in Bremen, Paderborn University, the Institute for Robot Research in Dortmund, the Institute for

Product Systems and Construction Technology in Berlin, and the Isra Company in Darmstadt are also participating in the development of the Rotex.

Europe: Ariane V Booster Tested

93WS0287A Paris LE FIGARO in French 17 Feb 93 p 11

[Article by Jean-Paul Croize: "First Stationary Flight for Ariane V Booster"]

[Text] *On a special test bench at Kourou, this enormous booster burned 273 tons of solid propellant in 130 seconds. The future European launcher will have two such boosters flanking its main engine.*

The solid-propellant booster of the future European rocket Ariane V, whose first flight is planned for October 1995, underwent its baptism by fire at Kourou yesterday, passing its first test successfully there at 1722 hours. Considered the most powerful engines of this kind to have been developed in Europe, these boosters have entailed an investment thus far of around 7 billion French francs [Fr] by the ESA [European Space Agency], which is financing the Ariane V development program for a total amount of around Fr35 billion. On the technical level, the perfecting of these engines is indispensable to the future version of the European rocket, whose architecture differs profoundly from that of the previous versions. As is also the case for the NASA shuttle, without these boosters coupled to the launcher's main engine, the lift-off would be impossible.

"In itself, this booster is more powerful than the present Ariane IV version," ESA officials point out. Weighing a total of 272 tons, this Ariane V "solid-propellant acceleration stage"—or EAP in the engineers' jargon—carries some 237 tons of a highly explosive alumina-based solid propellant designed to deliver a 540-ton thrust during the first two minutes of the rocket's flight, when the need for energy is maximal, to accelerate to the extent possible a launcher weighing some 730 tons at lift-off.

Without these engines, developed for the ESA under CNES [National Space Studies Center] responsibility, there simply would not have been an Ariane V. The two units will be attached on either side of the rocket's main engine and will develop a thrust of 1,100 tons, or 90 percent of the required total of 1,200 tons, until their separation at 60 kilometers from the earth, after 130 seconds of operation.

Ten times heavier and more powerful than the missiles of the French nuclear deterrent force, they are, from the standpoint of power as well as size—measuring, as they do, 3.03 meters in diameter, and over 30 meters in height—the biggest solid-propellant rockets ever built in Europe, and the world's second biggest. Only the American shuttle's boosters top them, burning 500 tons of solid propellant to deliver a thrust of around 1,000 tons.

A 1,000-Ton Anchorage

Understandably, therefore, exceptional safety measures were taken in the Guianan forest, approximately 20 kilometers from Kourou, where the future Ariane V launching complex is located. The spectators were not allowed to approach any closer than 5 kilometers away from the "forbidden zone," the site of this "stationary launch," termed "en bombe" and designed to test the behavior, on the one hand, of the solid-propellant mixture, consisting of three segments; and on the other hand, that of the engine developed for the booster, without worrying about the booster's structure per se.

So as to limit explosion risks, the test was carried out using a reinforced structure 35 mm thick, whereas the thickness of that of the real boosters will not exceed 8 mm. However, it was conducted in a vertical position, so as to simulate real operating conditions. The propellant, enclosed in its casing, was secured to an infrastructure almost 50 meters tall and weighing over 1,000 tons, embedded astride an enormous ditch 60 meters deep and 200 meters long, dug in the Guianan soil, to channel the gases produced during the test.

Moreover, taking no chances whatever that this prototype might somehow break out of the test enclosure, it was solidly moored to the test bench infrastructure with provisions for allowing it to move not more than 5 centimeters toward the top, and two safety systems designed to counteract any tendency to exceed that limit. These consisted essentially of, first, a set of enormous collars designed to rein it in within tenths of a second should it become necessary; then, a set of strong steel cables 300 meters long to pull it back down to the ground should it still have succeeded in taking the road to the sky. Some 600 points of measurement remain to be analyzed.

Europe: Cost, Energy Savings With RITA Electric Motor for Satellites

93WS0287B Paris LE FIGARO in French 23 Feb 93 p 11

[Article by Albert Ducrocq: "In Space, Eyes Turn to Electric Motor"]

[Text] *Things learned from the RITA [Radio Frequency Ionization Thruster Assembly] experiment: One kilogram in orbit costs 160,000 French francs [Fr], and that includes one kilogram of ordinary satellite fuel. Ion-powered systems would enable significant energy and cost savings.*

Last August, the Atlantis shuttle released the Eureca [European Retrievable Carrier] instrument platform, which is currently orbiting the earth at an altitude of some 550 kilometers, while waiting to be retrieved by Endeavour in the spring. The engineers will then be able to examine its equipment, and particularly, after a period of service, its electric space motor RITA. One of the objectives of this experiment was to test a thruster designed to be put aboard communication satellites before the end of the century.

The principle of this type of motor—often referred to as a plasma engine or ion engine [as published]—is simple. Whereas in a chemical-propellant engine, with the best conventional storable fuels, it is difficult to obtain an ejection velocity higher than 3.5 kilometers per second, the performance of the electric engines presently under study already exceed 10 times that value. This means that for equal mass, a satellite could, in the absolute, be kept in orbit 10 times longer, with all the benefits that would ensue from an operational viewpoint. A kilogram in geostationary orbit costs Fr160,000. To ensure a long life expectancy, a satellite of the Intelsat VII type, whose specific weight is 1,420 kg, must carry, in addition to its own weight, 2,160 kg of propellant.

Very Low Thrusts

The high ejection velocities obtainable with the electric space motor are owing to a separation of the two functions—i.e., creation of a given value of energy, and application of this

energy to the ejection of a substance—that are customarily the province of the substance itself. In an electric motor, a separate source produces a current. This current is then sent to a small linear accelerator, the traditional combustion chamber having been replaced by a plasma-producing zone. What actually occurs is that the atoms of a fluid—whose role is passive—are dislodged. Once electrically-charged particles have been obtained, it suffices, if they are positive, to attract them by means of a negative electrode. Their velocity is determined by the potential applied to this electrode. Performance is limited solely by the need to supply an energy whose value increases as the square of the velocity.

The solar batteries with which satellites are equipped can be a highly efficient source, provided the satellite's operational requirements can be satisfied by extremely low thrusts, generally of the order of magnitude of a gram-weight. This suffices for positioning and altitude correction maneuvers in geostationary orbit, it being understood that the thrusts in question will be delivered during very long periods of time, and will thus enable maneuvering with a very high degree of precision. The experts have long envisioned the application of this approach. In 1970, the Americans tested a 1.5-kilowatt motor aboard their satellite SERT 2. The Russians mounted a motor driven by mercury vapor ionized by means of electrical discharges, aboard a Meteor. It had a power of the same order. In France, the SEP [European Propellant Company] undertook research to develop a motor designed for Intelsat satellites, and ONERA [National Office for Aerospace Studies and Research] studied a prototype driven by cesium ions obtained by passing the cesium through porous tungsten at a high temperature.

244 Hours of Operation

The principle of the RITA motor aboard Eureca is very unique. As indicated by its acronym—for Radio Frequency Ionization Thruster Assembly—the ionization of a gas is obtained by a resort to radio techniques; that is, by transposing the scenario of the transmitting triode, which was in great vogue during wireless telegraph's infancy, when a coupling between two of the triode's electrodes—its grid and its plate—generated oscillations. These oscillations were created in order to impart a to-and-fro movement to the travel of the electrons. In RITA, xenon is used and is thus converted into plasma. This presents a very elegant approach, despite the risk of a cable failure owing to melting, under the very high current intensities called for by the power required to accelerate a flow of particles.

Before the launching of Eureca, the Europeans had indicated that they would be happy if RITA operated just a few hundred hours. As far as is known, the system behaved well for 244 hours before failing owing to a cause that Fred Schwan—head of Deutsche Aerospace's space activities—deems irremediable. Hence the major interest in retrieving the device—something that has not been done for any previous electric space motor—because by learning more about its behavior in flight, it should be possible to take the necessary steps toward creating a perfectly reliable operational system down the pike.

Plans call for an initial use of RITA aboard Artemis, the future European satellite designed to collect data, whose launching is targeted for 1997. Artemis is to be equipped, on the one hand, with two RITA motors, and on the other hand with two mercury-driven electric motors. The Americans are planning to use a similar approach aboard Telstar 4, as are also the Japanese, aboard ETS 6. It is as though, after a long period of gestation, the electric space motor is finally about to impose itself.

Germany: Nine Firms, 36 Research Institutes Participate in D-2 Spacelab Mission

93WS0298 Duesseldorf VDI NACHRICHTEN in German 12 Feb 93 p 16

[Article by Dietrich Zimmermann: "The Countdown is Underway For the D-2 Mission; The Astronauts Themselves Are Subjects of Research"]

[Text] The countdown is underway. If it does not have to be interrupted again, the second German Spacelab D-2 mission will be launched on 25 February 1993 from the Kennedy Space Center in Florida. On board the American space shuttle Columbia, the spacelab is to circle the earth for nine days at an altitude of 300 km. On it will be more than 90 experiments, supervised by the two German astronauts Hans Schlegel and Ulrich Walter.

The launch of the D-2 will mark the resumption of a program which began in 1983 with the flight of the first European Spacelab Mission and continued in 1985 with the German D-1 Mission.

The D-2 was originally scheduled to be launched in 1988, after the results of the experiments conducted on these two missions and the experience gained from them had been evaluated. But the Challenger disaster in January 1986 temporarily ended the dream of an ongoing program to conquer space at minimal risk.

Consequently, the interval between the two German spacelab flights has been eight years, rather than the originally planned three. Naturally, such imponderables make it difficult to convince industry to play an increased role in experiments in space, which are generally very expensive.

Nonetheless, 25 of the 64 German experiments are industrially sponsored. The firms are interested in, among other things, the automation and robotics systems on board the shuttle; the experiments in cryogenics, which behave differently in zero gravity; the growing of protein crystals, which yields considerably more uniform results when performed in space; and the experiments with yeast culture mutations.

The D-2 research program is divided into six areas of concentration. The vast majority of the experiments are in materials and life sciences; they are all housed in the "racks," as the experiment cabinets are called, located in the interior of the barrel-shaped laboratory.

Then there are the individual projects in the fields of process engineering, earth observation, atmospheric physics, and astronomy. The corresponding equipment, such as a "galactic ultra-wide-angle camera" and a "multi-spectrum scanner," have been installed on an exterior platform mounted behind the laboratory. This platform also houses containers with automatic experiments and material samples.

The number of experiments is vast. For example, the melter in the material science double rack "Medea," will be used for an attempt to grow gallium arsenide crystals of a higher quality than is possible on earth.

This semiconductor material, which can be used to manufacture extremely efficient optoelectronic chips, semiconductor lasers, and integrated circuits, has an extremely promising future, provided that the procedure for growing the base crystal can be simplified and improved. The growing of doped silicon crystals during the D-1 mission yielded important insights into crystallization processes, which led to improved growing techniques. This success has led scientists to hope that similar results can be achieved with gallium arsenide.

One of the experiments in the appliance laboratory will use liquified material as the basis for producing structures similar to turbine-buckets, in which are suspended superfine oxide particles which will serve to reinforce the base alloy. Because of the low mass of these particles, this would not be possible on earth. In another experiment, the astronauts will attempt to produce homogeneous lead-bismuth alloys. Altogether, the double rack of the appliance laboratory, which will be making its third flight aboard the spacelab, will house and provide for nearly a quarter of all the D-2 experiments.

The life sciences are divided into two areas. The "Anthro-Rack" is particularly suited for experiments in human physiology. It houses, among other things, a breathalyzer, an echocardiograph, ultrasonic equipment, a high-speed centrifuge, and other equipment for analyzing blood.

The astronauts themselves are also the subject of research. Using the most sophisticated medical technology laboratory ever present on a manned space flight, the astronauts will conduct approximately 20 different experiments on the regulatory mechanisms of the circulatory system and various organs of the human body. These experiments actually represent the beginning of the next phase of space travel: the international space station "Freedom." European scientists will share the use of this station via, among other things, their own laboratory module.

The second life sciences area of concentration is housed in the Biolab rack. Numerous experiments will provide information on such cellular and microorganismic functions as the perception of gravity. The scientists will observe developmental and behavioral-physiological processes and use electrical impulses to fuse cells together in order to compare the results with corresponding experiments on earth. Finally, the effect of cosmic radiation on both human beings and biological objects such as bacterial spores, seeds, and insect eggs will be studied.

Participating in the program are 36 institutes from 20 German universities, the German Aerospace Research Institute (DLR), institutes of the Fraunhofer and Max Planck Societies, and nine German industrial corporations.

Also participating in the program are 22 international university institutes, ranging from the University of Paris to the University of Texas, as well as other foreign enterprises and organizations such as the Tokyo Space Technology Corporation. Responsibility for the preparations for the mission was shared between the DLR and Development Group North (ERNO) in Bremen, now part of German Aerospace AG (DASA).

It is worth taking a look at the cost of the spacelab. The cost of developing the 3.5-ton research facility totalled 330 million German marks [DM]. Payload integration among the German corporations cost an additional DM130 million; mission control and operations by DLR was another DM180 million; and launching costs and other services rendered by the American space agency NASA totalled an additional DM250 million.

Of this, the Federal Ministry for Research and Technology (BMFT) is providing DM640 million, the DLR is providing DM120 million, and DM130 million is being contributed by foreign partners such as the European Space Agency (ESA), NASA, and Japanese industry.

Millions of television viewers will be able to follow the two German astronauts and five American astronauts live for 10 days as they blast off into space on Mission D-2. Beginning with the launch on 25 February and ending with landing on 6 March, a television program will be produced in the DLR control center in Oberpfaffenhofen which will transmit pictures directly from the space shuttle Columbia.

Also included on the program will be interviews with space experts as well as documentary films on such subjects as the training of the astronauts. The program is to be hosted by television journalist Ranga Yogeschwar.

"Space Television," as the "Program from Outer Space" has been titled, will be broadcast throughout Germany with the help of Telekom. The DLR, which is acting as Mission D-2 project leader, has promised a fascinating program. "The viewer will see the same pictures that our experts in the control rooms see," says DLR spokesman Dr. Michael Schmidt.

The program will be broadcast for six hours each day, from 11:00 a.m. to 5:00 p.m. (During the first day, it will be shown from 2:00 p.m. to approximately 8:00 p.m.) The program will be broadcast throughout Germany on Telekom satellite DFS 2 (German Telecommunications Satellite) Copernicus. The receiver specifications are as follows: orbital position: 28.5 degrees east; transponder: A2; downlink frequency: 11.525 GHz; polarization: X; audio channel: 6.56 MHz.

Any commercial satellite receiver with a diameter of at least 90 cm will be able to receive the program. Several cable networks are also planning to broadcast "Space TV."

Anyone unable to receive the pictures from outer space at home will be able to see the program at one of the numerous information centers. The plan is for museums, universities, planetariums, and observatories to receive and show the program. Department stores and the larger daily newspapers also plan to make the program available to the public.

These broadcasts, together with reports in the normal news media, will give the general public its first opportunity ever to witness a space mission, close up and personal. Numerous cameras have been mounted in the spacelab and shuttle to follow the astronauts as they conduct their experiments.

A "sightseeing tour" of the shuttle, including the cockpit, is also planned, during which a German astronaut, hanging weightless in front of the camera, will guide the viewer through the individual rooms. Exterior cameras will also provide fascinating pictures of the earth.

Germany: Airbus A340 To Enter Into Service in March

93WS0299 Duesseldorf VDI Nachrichten in German 12 Feb 93 p 36

[Article by Franz Fedler: "Long-Range Airbus To Begin Regular Service; Eight Pilots Test Six Passenger Aircraft in Most Comprensive Test Ever Conducted" First Paragraph is VDI NACHRICHTEN introduction]

[Text] The first four-engine long-range airbus, the A340, was delivered to Lufthansa in Frankfurt last week. Lufthansa intends to begin using the A340-200 for regular service over the northern Atlantic on 15 March. The new aircraft was subjected to one of the most extensive test programs ever conducted. Pilots and observers from the testing and evaluation agency participated in nearly 200 of the approximately 750 test flights.

The byword for the A340 is "nonstop." The new airbus can fly to all points on the globe, even as far as southern Australia, without stopping to refuel. The test program also ran "nonstop," and was concluded, as scheduled, at the end of December 1992. A total of six jets were involved in the most extensive test program ever conducted by Airbus Industry. During the course of 750 test flights, the jets were flown more than 2,400 hours.

The approval of the aircraft marked the conclusion of an overall evaluation of the A340 which, since its beginning in 1988, resulted in approximately 900 conferences throughout Europe and required over 1,000 pieces of documentation. The tests verified that the A340 can tolerate extreme operating conditions, ranging from high-altitude airports at extremely high temperatures to arctic conditions, and from being struck by lightening to being exposed to high-energy radar and radio signals.

One Airbus Industry test pilot who took part in the program is Udo Guenzel, an engineer and the chief pilot. He is a member of an eight-man team that conducts tests on new models of aircraft. Two other Germans, two Englishmen, and three Frenchmen make up the remainder of the team.

Although each test pilot is capable of flying any airplane, each one of them generally specializes in a particular area of aviation technology. Guenzel is responsible for the engines and monitoring flying performance. To remain on schedule, it will be necessary to complete the modifications called for by findings by Guenzel and his colleagues before the A340 is certified.

In order to obtain approval of the A340 within the shortest time possible, the test program was conducted on six different aircraft. The first of these was retained by Airbus Industry following the conclusion of the test flights. The five remaining aircraft are to be delivered to clients after they have been retrofitted.

As a trained and licensed test pilot, Guenzel needs no additional qualification to be either able to or authorized to fly the huge A340. "We are accustomed to testing new aircraft," says Guenzel. "Nonetheless, before we fly a completely new airplane for the first time, we familiarize ourselves with it on the simulator. This technology is now so advanced that it closely approaches reality." Consequently, there were no surprises on the maiden flight of the new airbus. Guenzel adds: "Very rarely do we find serious differences between the simulation and the actual aircraft."

Despite the simulator, Guenzel's profession is a risky one. "The most dangerous phase of a test program is the first 15 or 20 flights in an entirely new aircraft," he reports. "Buffeting is especially dangerous, for example." By this, the pilots mean the effect of aerodynamic forces on the wing structure. A good wing structure must be cushioned in such a manner that it does not become subject to sympathetic vibration, which could destroy the wings. Or, more simply, a wing must not be able to vibrate enough to cause itself damage.

Early test flights of the A340 indicated aerodynamic problems with the wings. This necessitated a modification of the profile of the lower wing surface, immediately in front of the two outer motors. Naturally, these modifications have already been integrated in all production aircraft delivered to customers. Now the engineers are concentrating on an aerodynamically improved method of mounting the engines.

Lufthansa engineers have ascertained that a flight from Buenos Aires to Frankfurt with 228 passengers on board will require 82,484 tons of kerosine. According to this estimate, the new A340 will result in a 31 percent savings over the DC-10-30, which it is to replace. The noise and exhaust figures of the four-engine A340 are also considerably lower than those of the DC-10-30. The passenger will perceive the engine noise during takeoff to be quite loud, however. The low drone dubbed "Bass Saw Noise" by engineers approaches that of the Airbus A320. Lufthansa and Airbus Industry conducted a jointly financed modification program on the smaller aircraft, which provided a solution for the problem. Werner Scholz, project head of Lufthansa's A340 program, commented: "We took precise measurements of the noise escalation. All of the figures for the A340 are lower than those for modified A320 models. Furthermore, we have complied with all contractual noise level restrictions."

Guenzel admits that test flights can send his pulse racing. "We fly at the limits, we are continually pushing the edge in order to put an aircraft's entire performance spectrum to the test. But a nose dive straight at the ground, that's what gives the job its spice." Thus far, Udo Guenzel and his colleagues have escaped injury. After 20 years in the business, the test pilot believes that "God has been watching over Airbus." Although there have been instances of human error, "It has not resulted in a catastrophe."

The field tests did, however, result in surprises of a different sort. For example, they proved that the computers used by the design engineers are not always correct. During the first refueling attempt, they discovered that the A340 can hold approximately 3,000 more liters of kerosine than had originally been calculated. This silent reserve bothers no one.

Airbus A340 Specifications

Length	59.39 m
Wingspan	60.30 m
Height	16.91 m
Cabin Width	5.4 m
Airspeed	890 km/h
Maximum Cruising Altitude	12,500 m

Airbus A340 Specifications (Continued)

Maximum Range	A340-200 with 263 Passengers	14,300 km
	A340-300 with 295 Passengers	13,300 km
Approximate Price		$100 million

Germany, Japan, Russia To Develop Joint Recoverable Space Capsule

93MI0354 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 28 Jan 93 pp 9-10

[Text] On 17 December 1992 the German Space Agency (DARA) and the Japanese Industry Ministry (MITI) signed an agreement on the joint development and operation of a recoverable capsule that they had been planning for some time. The building of the capsule will be managed by German industry (German Aerospace's ERNO [Northern Development Consortium] Space Engineering jointly with OHB Systems), which will be collaborating with the Russian KB Salyut company: it is to be launched and landed in 1994 by the Japanese M3-Sil rocket at Woomera, Australia, following a joint operational phase headed by the German Aerospace Research Institute (DLR), Oberpfaffen. In addition to MITI, the Japanese partners are the Institute of Space and Industrial Technology Development Organization (NEDO), together with industrial firms.

The scientific payload of the capsule will be provided jointly by German and Japanese scientists; the capsule will weigh approximately 800 kg and stay in orbit for about five days. The joint work will focus primarily on reentry technology, and will include research and technology programs that will be of major significance for future European and international space technology, such as the development and flight testing of reusable thermal shield materials and measurements for testing computer programs on the physical processes that occur during reentry into the atmosphere. In addition to Braunschweig Technical University, the DLR at Stuttgart, Stuttgart University, and other bodies are also taking part in the experiments. The Japanese experiments give complementary coverage to the same topics.

In addition to research on reentry technology, the Germans will be conducting navigational experiments, and, during the flight phase, for the Japanese will be performing industrial microgravity experiments to exploit the further potential of the capsule.

The BMFT [Federal Ministry of Research and Technology] is contributing around 30 million German marks [DM] to this joint EXPRESS program, a third of which is likely to take the form of funding for the Russian space agency. In return, the Russians will make the Salyut capsule and their previous experience available. It would have cost around three times as much for Germany to go it alone.

EXPRESS is the first development project to be jointly carried out by the German and Japanese space industries. It is also serving as a pilot for closer technological cooperation by German industry with its Russian counterparts on space matters. The project will also boost cooperation between research institutes on reentry technology, which is crucial to future space developments.

AUTOMOTIVE INDUSTRY

New Automated, Lean VW Factory in Spain

93WS0281B Frankfurt/Main FRANKFURTER ALLGEMEINE in German 19 Feb 93 p 21

[News report: "The New Plant at the Mountain: Seat Opens Factory in Martorell; Japanese Production Methods; Shrinking Sales Markets"]

[Text] Martorell, 18 Feb—Monserrat veils its head. A haze lies over the Spanish mountain and over the Martorell automobile factory at its foot. Even the Seat executive's pride over the new plant, its shimmering shops, spotless corridors, and deserted green areas seem restrained. When the king of Spain dedicates the plant on the following Monday, it will not be the only cause for celebration.

Finally, the Volkswagen Group has a "superlean" car factory to show off, even if it has to present it to the public at a time of shrinking sales markets. Finally the Wolfsburg company can tangibly demonstrate how serious it is about the globalization strategy that it has adopted; at the same time, however, it must postpone similar plans in all parts of the company, cut back on promised investments, and cut budgets in half. Finally, Seat, which has been part of Volkswagen since 1986, is free of the stigma of inadequate productivity and can build cars with fewer people, although the Spanish public is not exactly applauding, given an unemployment rate of 20 percent.

The substantial investment from Germany is visible here: For the equivalent of 3.1 billion German marks [DM], VW has been planning since 1987 and building since 1990 on a 3 million square meter meadow around an old Seat plant. Another DM480 million was invested in the development of the new Ibiza—its predecessor model has been on the market since 1984. What emerged from this was a smart compact car, a condensed Golf measuring 3.80 meters in length. Seat wants to sell 150,000 units in the first production year alone, more than 70 percent of them abroad.

Under the VW roof, Seat has not only increased sales (1991: DM9.3 billion) and once again turned a profit (1991: DM134 million before taxes), but also increased its exports immensely. In 1992, of the approximately 360,000 vehicles produced under the Seat name (the Polo manufactured in Pamplona for VW is not included here), more than 70 percent were exported, explains Jose Gabriel Martin Aguilar, the company's head of exports. Around 100,000 units were delivered to Germany, where Seat has a market share of 2.4 percent. The second most important market is Italy (around 60,000 units), followed by France (around 40,000 units)

In Spain, with a market share of 10 percent, Seat is in fifth place on the vehicle registration hit parade. The entire Volkswagen Group has lost the leading position on the market that it had achieved, and with a 17 percent market share is now in third place behind the French manufacturers Renault and Peugeot/Citroen. Moreover, the Spanish automobile market is currently shrinking to an alarming degree due to the economic crisis: In January 1992, vehicle registrations declined by 52 percent compared to the same month the year before, Aguilar reports. For the entire year, he expects a decline on the Spanish market of 7 to 10 percent. Things do not look much better in the rest of Europe either. Thus it appears more than doubtful that Volkswagen will actually—

as announced in 1989—have invested a total of DM10 billion in its Seat subsidiary by 1999. At present, the trend seems to be more towards stepping on the brakes. Twenty days of short time by April have been agreed to for the former Ibiza plant "Zona Franca" near Barcelona, where the Toledo and Marbella models are still being built. And by 1995, the number of workers should be reduced from currently more than 23,000 to 19,500. Thus, the people in Zona Franca especially are afraid for their jobs, and regard the Martorell prestige project as a job killer. Even if the Seat board of directors guarantees that a capacity of 1,000 to 1,500 vehicles a day will definitely remain in Zona Franca, and even if there is still talk of a small car project with Suzuki.

In any case, Martorell should be reserved for the Ibiza and future "intermediate-class" models, explains Seat production head Peter Walzer. He is trying to increase awareness of the clarity of the white building in front of the Martorell mountain massif and of the blessings of automation. There they stand, ready for an emergency: a silent forging press, a room for bodywork occupied by robots, an environmentally friendly paint shop, and a final assembly area patterned after the famous Shop 54 in Wolfsburg. It is intended that 1,500 cars roll off the assembly line here every day, once production is really under way in 1996, one every 53 seconds. That corresponds to an effective production time of 20 hours per car at an hourly wage of DM20. One day, 6,000 people are supposed to work here; at present there are only 3,400. Each one of them spent an average of 218 hours being prepared for his new task. In 1996, he should be able to build 60 cars a year. That is nearly three times as many vehicles per employee as in Zona Franca, which is the source of more than half of the workers at Martorell; another 900 had to be taken on from the predecessor plant in Martorell, because that is how the labor union wanted it.

Work is done here in groups; in public postings strict records are kept of each individual's skills and absenteeism, on production volumes, and on the level of quality achieved in the group. Sensors probe the nascent car and uncover even the tiniest deviation from the target value. The finished product must demonstrate how water-tight it is in a rain tunnel, and show that nothing rattles or jams on a vibration course. Transmissions come just-in-time from the Seat plant in Prat de Llobregat, and preassembled components come from the nearby industrial park. Fifteen mostly foreign suppliers with 700 employees have set up shop in Martorell and deliver their products after an electronic call.

However, the engine of the new Ibiza does not come from Spain, but rather from Salzgitter and Mexico. It is only finished in Martorell. Walzer estimates the entire import volume of the Seat plants as 40 percent of the material costs or DM2 billion—with a declining trend due to the devaluation of the peseta. Suppliers and service and transport companies will create more than 24,000 jobs in Spain in the years ahead, Seat claims to have discovered in a study. In the meantime, Spanish newspapers are making fun of the fact that Seat is even importing from Germany the fertilizer for the grass lawns in Martorell.

German Project Develops Ceramics For Car Engine Valves

93MI0356 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 28 Jan 93 pp 10-11

[Excerpt] The development of extremely reliable ceramics that withstand high thermal and mechanical stresses as a basis for high-performance engine and turbine components was the subject of a project funded jointly by the BMFT [Federal Ministry of Research and Technology] and industry from 1986 to the end of 1992. The Max Planck Institute of Metals Research Powder Metallurgy Laboratory in Stuttgart, Bayer AG, Hoechst AG, Munich Technical University, and Daimler-Benz AG were involved in the project; it cost a total of 17.2 million German marks [DM] by the industrial partners.

The project was based on the observation that the superiority of ceramic materials' thermal stability compared with metals permits their use at higher working temperatures and thus improves efficiency. Their superior sliding and wear behavior and their lower density substantially reduce friction and inertia losses in moving components.

Now that the project has been completed, silicon nitride seems a promising substitute for the metal valves usual in internal combustion engines. Ceramic valves significantly reduce not only gasoline consumption and pollutant emissions, but also the noise generated by present-day vehicle engines.

The areas covered by the project range from the production of advanced ceramic powder (powder design), through research into optimal material structures (structure design), to the development of methods and models for predicting the durability and analyzing the reliability of the ceramic components under simulated thermal and mechanical stresses.

German manufacturers can now produce ceramic powders with specified particle form and size distribution, and process them with various sinter additives to produce components with top mechanical values. Knowledge of sintering processes has reached the stage where, on the basis of component dimensions, structures with differing grain sizes and extensions can be modeled homogeneously and targeted amorphous or crystalline phases can be created. This makes it possible to tailor different silicon nitride materials with the right strength and reliability parameters, even for operations temperatures above 1,000° C. This directly acquired know-how should now be exploited by industry as fast as possible and translated into competitive products. [passage omitted]

Further information is available from:

- Max Planck Institute of Metals Research. Institute of Materials Science Powder Metallurgy Laboratory, Heisenbergstrasse 5, D-W-7000 Stuttgart 80, Tel. 07 11/68 61-0, Fax 07 11/68 61-131; or
- Juelich Research Center GmbH, Materials and Raw Materials Research Project Management Team, P.O. Box 1913, D-W-5170 Juelich, Tel. 02461/61-0, Fax 02461/61-23 98.

COMPUTERS

Germany: Subsidiary of Japanese Firm Using DEC Alpha Processor for Real-Time Simulation

93WS0260A Duesseldorf VDI NACHRICHTEN in German 15 Jan 93 p 14

[Article by Manfred Grotelueschen: "Graphics Computers Simulate in Real Time"]

[Text]

Applications Software Must be Available

Graphics images and simulations require high-performance workstations to solve even complicated tasks quickly. Among the vendors, one manufacturer is betting on a special trump card by installing the new Alpha processor from DEC in his computers.

Visualization and representations in three dimensions are among the important applications of graphics computers today. "However, most workstations still function in two dimensions. They are too expensive and mainly not powerful enough for rapid 3-D applications," qualifies Eberhard Witte. For solid modeling, for handling an engine block model or a molecular design, however, high computing speeds are becoming more and more important, believes the director of Kubota Pacific Computer in Cologne.

To show 3-D graphics and still be able to account for time as the fourth dimension, a bottleneck must be eliminated. This is the bottleneck between large background computers (Cray, Convex) and the graphics workstation. Considerable changes would result from this, such as in fluid dynamics, in animation and finite-element calculations. These all require enormous computing power. For these tasks, Kubota and even its competitors now offer computer generations that, according to Witte, provide more than 100 Specmarks of computer power, approach 3 million vectors per second in graphics capability, and are still designed as desktop computers. The previous industrial users of Kubota computers include German companies, e.g., an aerospace company in the image processing of satellite data, an automobile supplier with crash tests of vehicle seats, the research department of a chemical concern in molecular design. They all use computers processing up to 196 Mflops (million floating point operations per second) and range in price from $100,000 to $200,000.

For March, Kubota's director has announced a new desktop and tower computer generation. This will be available in Germany at the low end for 70,000 German marks [DM]. The background for this improvement in the price/performance ratio is an agreement with Digital Equipment (DEC). Based on this agreement, the developers of Kubota can incorporate the new Alpha processor (64 bits, 200 Mips), only recently introduced by DEC, into their machines. For this technology, Digital is supplying the Alpha computer, Kubota is providing the graphics component, according to Witte. He is convinced that, "This provides a completely new class of graphics data processing. In this way, it becomes possible to run sophisticated animation in real time."

In spite of a recession in many user branches, the five or so vendors of high-performance workstations active on the German market expect increasing revenues. In this "exploding market," according to Witte, "there is hard competition in spite of this." If you want to survive, you must first provide, with your computers, a good price/performance ratio, then satisfactory support, and finally the required applications software, too. "Customers are not buying naked computers. They want solutions and this means that the applications software must already be available on the market."

In this point, Kubota's head in Germany sees the company in a good position because all the computer programs developed for DEC computers also run on his workstations. This is because these machines are compatible with one another. Among the most important European customer countries for high-performance workstation, Witte sees the German-speaking area, England and France, speaking from his five years of experience at Kubota. There is also a great potential in eastern European countries such as Hungary, Poland and Czechoslovakia where there is a pent-up demand for high-tech computers. Even in the northern countries, Scandinavia and Finland, there is a strong demand.

Initially, there is no money to be made with workstations in the new Federal Lands. This is because there is no money for investment, with the exception of individual cases. In spite of this, "I would rather open a sales branch in Berlin than in Munich," according to Witte, to have a presence there. The official start of the EC domestic market on 1 January had almost no significance because the workstation business is already European in scope. Kubota Pacific GmbH in Cologne has 10 employees at this time. It is a subsidiary of Kubota Pacific Computer, Inc., headquartered in Santa Clara, California. Its parent, the Kubota Corp., is a Japanese concern offering over 2000 different products. These range from agricultural machines to pipes and building materials. The company has its headquarters in Osaka and views itself as a high-tech forge. As a consequence, it entered the computer business in the 80s.

German Government Report Claims Post-Chernobyl Radiation Levels Lower Than Previously Thought

93WS0260B Duesseldorf VDI NACHRICHTEN in German 15 Jan 93 p 19

[Article by Bettina Reckter: "Limits Not Reached by Far"]

[Text]

Study on Environmental Radioactivity

Exposure in New Federal Lands Less Than Assumed

What extent did the environmental radioactivity achieve in the new Federal Lands even years after the disastrous reactor accident in Chernobyl on 26 April 1986? Have the values normalized or are the population and the environment still suffering high radiation exposure levels? The Federal Office for Radiation Protection (BfS) in Salzgitter attempted to clarify these questions and others in a study. Their results have now been published.

Until German unification on 3 October 1990, radioactive contamination in the vicinity of nuclear plants, in mining areas, and in the entire territory of the former GDR was monitored by the State Office for Atomic Safety and Radiation Protection (SAAS). After unification, the Federal Office for Radiation Protection and the Joint Agency of the Lands of Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, and Thuringia for Reactor Safety and Radiation Protection (GEL) performed this function. The radiation exposure of the population there for the year 1990 was determined from these results.

Normally, the release of radioactive materials from nuclear power plants is measured by the operators of these plants but checked by the responsible government authorities. The data of the nuclear power plants at Greifswald and Rheinsberg and the atomic center at Rossendorf show that the magnitude of radioactive emissions in 1990 has not essentially changed from the previous years. In addition—and this is the most important result—the officially specified limits were not

reached by a wide margin. With this, it can be assumed that at least these three plants do not present an increased environmental risk. This is a conciliatory result when the poor reputation enjoyed by the nuclear operations of the former GDR is considered.

Even in 1990, it was a matter of monitoring the environmental contamination created as a result of the reactor accident at Chernobyl. However, tests of soil and water samples were limited to certain areas. These were areas where an above-average exposure level was created at that time and for this reason contamination changes could be proven inexpensively, as well as in the area representing the average radiation exposure level in the former GDR.

The radioactive radiation to which the population in the former GDR was exposed by the exposure level of the environment coming from the reactor accident arises, on the one hand, from external radiation and, on the other, from internal radiation. External radiation is caused by the radionuclides that continue to be present in the topmost soil layer and come from the fallout as dry or moist precipitation. Internal radiation can be traced to the consumption of food usually subjected to small amounts of radiation.

A noticeable reduction in the cesium-137 content in arable soil, meadows and pastures was not expected by the scientists because cesium binds relatively strongly to the clay materials in these soils. However, because of this, it is only available in very small quantities for the plants. This explains both the fact that the exposure values for the soils change only slightly and that cesium-137 concentrations in agricultural products further decreased. Consequently, the radioactive cesium concentration of the grass from the pasture areas investigated has dropped by one half over the previous year despite almost identical amounts in the soil.

In undisturbed soil profiles, thus in areas without agricultural activities, the topmost soil layer also had the highest cesium-137 values. However, the hyphae of forest mushrooms grow in this layer. These hyphae permeate the forest soil as a far-reaching mycelium. On account of special physiological characteristics, a few types of mushrooms, such as cepe, accumulate cesium to an extremely high degree. For this reason, the scientists also assume that the cesium concentration in these mushrooms can only drop at the same rate as that of the exposure level in the soils in which they grow.

A much greater reduction in the radionuclide concentration was seen in other agricultural products, however. A comparison of the mean values for beef and pork with the corresponding values of the previous year showed that the cesium concentrations in beef dropped by up to 35 percent in 1990 as compared to 1989, and by 29 percent for pork. For fresh milk and powdered milk, the concentration of cesium dropped by one half. The values for strontium-90 hovered at the level of values from the time before the reactor accident in Chernobyl, according to the results of the study.

Besides individual food items, the magnitude of the radiation exposure level from the entire food spectrum was also of interest. This showed that the radioactive cesium concentration dropped by about 45 percent as compared to 1989. The strontium-90 concentration was even in the range of values from 1985—thus on the level prior to the accident.

On the whole, the population in the new Federal Lands in 1990 was exposed to a total radiation level of about 3.8 mSv [milli-sieverts] on average from natural radiation sources in the open or in buildings, and from food.

Siemens Builds Superfast Computer for Neural Networks

93WS0272A Stuttgart BILD DER WISSENSCHAFT in German Feb 93 pp 102-104

[Article by Bernd Mueller: "Assault on the Brain"; first paragraph is BILD DER WISSENSCHAFT introduction]

[Text] The fastest neurocomputer in the world: With SYNAPSE—a superfast computer for simulating neural networks—Siemens has gained a lead over the competition. Language and image processing in real time are now within reach.

SYNAPSE does not exactly look like a milestone in computer technology: The fastest neurocomputer on the planet resembles neither the colorful towers of supercomputer manufacturer Cray-Research nor the gigantic wardrobes of industry giant IBM. The machine inconspicuously sitting on the table at the research and development center of the Munich electronics company Siemens is more reminiscent of a personal computer.

The fact that you should not judge a book by its cover becomes clear after an impressive demonstration. For a test program in which four million multiplication and addition operations must be carried out, a fast SUN Sparc Station 2 work station needs just under 19 seconds. SYNAPSE is finished in only three seconds. However, "in order to even be able to recognize the computing time, we let the test program run a thousand times during these three seconds. One pass takes only three thousandths of a second," notes Dr. Ulrich Ramacher, the head of the eight-person development team. According to previous tests, SYNAPSE is at least 8,000 times faster than the SUN work station. Ramacher says. "Actually, our computer is even much more powerful than that. Even compared to the next generation of SUN work stations, we will be able to maintain the 8,000 factor because we can free up some more reserves through improvements in the processor commands."

But what makes the mini-bolide so fast? One reason for its enormous power is that it is limited to the essential—and in the case of SYNAPSE that is the multiplication and addition of matrices as they occur in the simulation of neural networks. In order to be able to effectively calculate any neural network, a specially designed processor must know a maximum of 25 commands.

This resulted in MA-16, a superfast chip that was practically tailor-made for neurosimulations. "MA-16 is the biggest pure logic chip ever developed by Siemens—and it has worked from the word go," Ramacher reports proudly.

Within a 20 nanosecond clock cycle, the processor processes 16 neurons simultaneously and in one second it creates 800 million weightings (see box "How Neural Networks Learn" [not reproduced]). Even one MA-16 is so fast in this special discipline that Cray computers—which are considered the epitome of supercomputers—come across as lame ducks in comparison.

And to make the humiliation perfect, the Siemens developers have put eight MA-16s on one board, given the computer 128 megabytes of memory, in which the weights must be stored,

and connected the whole thing to a control board on which two fast Motorola 68040 processors monitor the computing process. The control board was developed and built by Prof. Maenner at the University of Mannheim as part of a cooperative project.

The main strength of the Siemens computer, however, lies less in the performance of individual components and more in the smooth interaction between components and its free programmability. The architecture of SYNAPSE was designed in such a way that any network can be created by way of an easy-to-understand user interface, using the popular C++ programming language. Thus, it is possible to configure SYNAPSE for any applications without having to take into account limitations of the hardware.

In this way, Siemens is taking a different approach than most U.S. or Japanese development labs. There, people have been trying for several years to connect neural networks in which each individual neuron is represented by a semiconductor element. In this way, it is hoped that the structure of the human brain can be simulated at some point. Although the computing speeds achieved thus far are convincing, it stumbles on concrete applications. Ramacher says, "These nanochips cannot learn or are not flexible enough. There will be no need for them in the foreseeable future."

In the estimation of Siemens researchers, the flexibility of SYNAPSE will mean that many research labs will be interested in the muscle man and use it as the powerful basis of their neural research. Ultimately SYNAPSE will make it possible to develop applications faster and more inexpensively than in the past. Siemens wants to provide the computer to a couple of select interested parties for a justifiable fee, which could amount to between 150,000 and 200,000 German marks [DM], according to Ramacher's estimate. Siemens does not yet have plans for a commercial product—the market is too small.

First the company wants to use SYNAPSE in-house and test it in conjunction with existing applications. A team under the leadership of Prof. Bernd Schuermann has made numerous products based on neural network architectures market-ready in recent years. For example, a program is already in use by major banks that can suggest future exchange rates and interest trends based on experience from the past 20 years ("Artificial Prophets" in BILD DER WISSENSCHAFT, No 4, 1992). Another program calculates in a rolling train the roller pressure that is appropriate to the respective environmental conditions. Siemens will be delivering this sort of system to a major steel company shortly.

But a normal work station is also adequate for these applications. Things get serious for SYNAPSE only when the real-time processing of language or even images is required. For example, SYNAPSE is to be used to develop the architecture of an artificial seeing device. "This could be used to monitor truck drivers, for example," Ramacher speculates. "The computer detects, even from slight changes in posture, whether the driver has fallen asleep and then emits an appropriate warning signal."

ESPRIT Project Protects Databases Against Copyright Violations

93BR0414 Amsterdam COMPUTABLE in Dutch 12 Feb 93 p 3

[Editorial article: "EC Justly Concerned About Databases]

[Text] A consortium of companies has developed a system that records the use of electronic information, restricts access to authorized information, and at the same time settles the compensation to be paid to the owner. This is the essence of the CITED [Copyright in Transmitted Electronic Documents] project, developed within the framework of ESPRIT [European Strategic Program for Research and Development in Information Technologies].

The model uses chip card technology to identify the user and to authorize him to download data from any database subject to specific conditions. An interesting feature is that CITED can be regarded as a generic model, which can be adjusted to specific situations by changing the parameters. The protection level, for instance, can be changed according to the type of information, while the user rights can also be further specified.

In addition to this ESPRIT project, the EC Commission has also taken several legal initiatives aimed at giving the information industry a reasonable chance of survival. Early last year, for instance, a draft directive for the legal protection of databases was proposed. This directive is based on a two-pronged protection approach. The traditional copyright will continue to exist for databases with sufficient originality in the selection or classification of data. For all other cases, the new database law will soon come into effect. It introduces a new intellectual ownership with an attenuated effect for a period of 10 years.

The European Commission has justly come to the conclusion that legal protection is one of the major problems of electronic information supply. The information industry in Europe is expanding rapidly and cannot afford to tolerate excessive abuse of intellectual properties.

DEFENSE R&D

France: NBMS Program Reviewed

93P60154 Paris AIR & COSMOS/AVIATION MAGAZINE INETRNATIONAL in French 7-13 Dec 92 p 44

[Text] France possesses five nuclear-ballistic-missile submarines (SNLEs) each equipped with 16 M4 missiles with greater than 4,000 km range. By mid-1995, on the SNLE-NGs (next-generation-SNLEs), these will be replaced by M45s.

Seven years of refurbishing later, the four "Le Redoutable"-type submarines will be equipped from now on with MSBS-M4 strategic ballistic missiles. With the initially so-equipped "L'Inflexible," the French Strategic Ocean Force's (FOSTs) SNLEs have now been equipped with the new over 4,000 km range M4 missiles each with 150 kt thermonuclear warheads.

This becomes important when taken in the context of France's nuclear deterrent capacity. However, excepting a short paragraph published in the national navy's very official magazine, this fact went by almost unnoticed. "COLS BLEUS" ("Blue Collars") had thus the privilege (!) of quietly announcing that, on the night of 17 November, an M4 missile firing was tested on board the SNLE "Le Foudroyant." According to the article, "the flight confirmed all expectations," "this test firing marks the acceptance of deploying the new weapons system on the "Le Foudroyant." Thus, "from now on, all FOST SNLEs will be equipped with M4 missiles."

In a previous issue of COLS BLEUS, the chief engineer of ADAM weapons technologies and studies announced in his

article that "Le Foudroyant" has begun sea testing early in September and will continue this until early 1993. He also mentioned that placing the submarine in active service will mark, on the industrial level, the completion of refurbishing SNLEs with M4 missiles, by the DCN (Ship Building Directorate) in Brest and Cherbourg, under the aegis of DGA (General Weapons Directorate). Launched eight years ago, somewhat before the launching of "L'Inflexible" (April 1985), the refurbishing the four first-generation SNLEs with M4 missiles (the "Le Redoutable" was not refurbished), should have replaced in service subsequently the submarines "Le Tonnant" (October 1987), "L'Indromptable" (June 1989), "Le Terrible" (June 1990) and finally, "Le Foudroyant"—with a delay of one year, following the budgetary staggering imposed by the 1987-91 law on planning. Thus, "Le Foudroyant," equipped with M4 missiles, will be placed in active service in February 1993.

450 150-kt "H" Bombs

At this time, according to our calculations, each SNLE will carry 16 M4 missiles each having six TN-71 150 kt thermonuclear warheads, that is, a total of 900 kt per missile and 14.4 mt per submarine. But in fact, the 16 missiles of a submarine do not carry 96 TN-71s, because "approximately" 11 warheads are replaced by penetration devices (support) and decoys. Thus, in practice, an SNLE carries regularly 85 warheads, that is 12.75 mt. So the FOST group embodies a 425 to 450 150 kt-"H"-bomb-nuclear strike.

Since 1991, four M4 missile-submarines have been operational, which makes possible the deployment of three SNLEs on the open sea, according to the ADAM engineer. With five available submarines, three or perhaps four could be on patrol at the same time, representing a strike force in excess of 50 mt.

However, beginning in mid-1995, the SNLE-M4s will be progressively replaced by the four next-generation "Le Triomphant"-type submarines. By that time, SNLE-NGs will be equipped with improved 5,000 km range (6 TN-75 warhead) M5 missiles, which in their turn will be replaced in 2005 by the new 10,000 km range-M5 missiles.

"Le Triomphant" will undergo testing beginning in mid-1993. "Le Temeraire," the second next-generation submarine, will begin testing in 1997 in order to be commissioned in 1998. The third vessel, as yet unnamed, will be ordered in 1993, to enter service in 2003. The fourth will be ordered in 1995.

The developing of M45 missiles to equip the first three SNLE-NGs began in 1988, and its first firing test took place in late 1991; the second is planned for early 1993. The M5 development began in November 1992 in order to equip the fourth SNLE-NG in 2005.

The M45 missiles, as the previous SLMBs have been, will be developed by Aerospatiale and G2P and SNPE), together with CEA for the nuclear warheads. Development price for the M5 missile is estimated to be 30.75 billion French francs (January 1990 prices).

ENERGY, ENVIRONMENT

France: CEA To Reorient Research Reactors

93WS0290C Paris AFP SCIENCES in French 4 Feb 93 pp 27, 28

[Text] Paris—Following the drop in French and European irradiation needs, the Atomic Energy Commission (CEA) has decided to adopt a new strategy in operating its two research nuclear reactors, OSIRIS in Saclay (Essone) and SILOE in Grenoble.

The decision aims to "better match resources" to the consequences of the "drop in medium- and long-term national needs, and the uncertainty affecting the supply and demand of irradiation services in Europe," says the CEA in a communique that was made public 29 January. The CEA has decided to maintain the two reactors, for a minimum of three years, and will reassess their operation in 18 months.

OSIRIS will run at maximum capacity (70 thermal MW) to provide technological irradiations needed for research and development in France's nuclear electrical power program. Work will be coordinated with Electricity of France and Framatome.

The operation of SILOE (35 thMW) will be cut back to match its workload; operating time will be limited to 130 days annually and its power will gradually be reduced by about 20 percent. The reactor will continue to be used for programs requiring production of neutrons on demand. The sectors concerned include basic research, industrial irradiations, and analytical studies for the development of fuels. SILOE operations teams and the teams in charge of engineering experiments will be reorganized.

The research laboratories were put into service in the sixties and are indispensable tools for developing current nuclear power plants. They are used to prepare the reactors of tomorrow (material and fuel tests) and to produce radioisotopes. The laboratories also provide scientists with the means to study condensed matter, materials, and alloys.

Germany: Relative Merits of Renewable Raw Materials Discussed

Government Favors Expansion

93MI0359A Wuerzburg UMWELTMAGAZIN in German No 1-2, Jan-Feb 93 pp 36-37

[Article by Bonn Correspondent Jochen Wagner: "On the Up-and-Coming—Bonn Wants to Step Up Cultivation of Renewable Raw Materials"]

[Text] Bonn wishes to encourage opportunities for cultivating renewable raw materials and counter the thoughtless overexploitation of the earth's limited resources. Federal Agriculture Minister Ignaz Kiechle believes that the ecological advantages present interesting prospects for renewable raw materials, particularly in the chemical industry. This applies to starch-based packagings (some 460,000 tonnes in the non-food sector in 1991) and to energy, fuels, textiles, and biotechnology. The post office, railways, armed forces, and public administration are named as potential bulk customers.

On the basis of a list of measures for immediate action, various federal ministries have sent instructions down the line that priority consideration be given to rape oil-based

environmental-comparable lubricants when purchasing non-reusable lubricants and hydraulic oils. The promotion of environmentally sound decentralized heat generation using solid biomass fuels will also be stepped up. The federal government wants to take on a pioneering role with this list, pointing the way for local authorities, industry, and the laender.

"Sponsoring pilot schemes and research and development projects will make renewable raw materials more competitive. The federal government wants to take on a pioneering role with this list, pointing the way for local authorities, industry, and the laender.

"Sponsoring pilot schemes and research and development projects will make renewable raw materials more competitive. The Federal Ministry of Agriculture alone will probably be making almost 55 million German marks [DM] available for this purpose, says Ignaz Kiechle. "Moreover, since 1986 the Bonn Research Ministry has spent some DM130 billion to fund renewable raw materials projects, and since 1990, budget appropriations have been increased from DM53 million to around DM100 million. With a total of DM90 million, the EC will also make a greater contribution to pilot renewable raw materials projects through its new agricultural research program.

The specialist "Renewable Raw Materials" agency will be set up under the auspices of the Agriculture Ministry in Bonn early in 1993 to accelerate the market launch of agricultural raw materials for industrial purposes. The plan is that the federal government, the laender, and industry will all be involved in the agency and coordinate their own funding measures with it. The agency's purpose will be to coordinate and oversee the various federal, land, and industrial research and development projects and pilot schemes so as to make individual measures more effective. The funding projects planned for 1993 will cost a total of DM55 million, plus DM2 million in private resources.

The new agency's main tasks include the design, testing and promotion of renewable raw materials product lines from production to application. It will also provide advice, manage projects, draw up technical information, and undertake publicity work.

Agency Will Boost Cultivation

Renewable raw materials already have an established place in German agriculture's crop range. Some 165,000 hectares, or 2.3 percent of arable land in western Germany (210,000 hectares in the country as a whole), are used for growing industrial raw materials. Industrial estimates put current German consumption of hydraulic oil at 200,000 tonnes. To cover this requirement alone would require 200,000 hectares of rapeseed.

In the future, 4 million hectares of Germany's agricultural land will no longer be required to grow salable foodstuffs. A Federal Research Ministry paper (based on a system analysis by the Karlsruhe Nuclear Center) states that increasing demand could lead to a further 200,000 to 750,000 ha agricultural land being turned over to industrial crop production by the year 2005. This means that within 10 years 410,000 to 960,000 ha could be growing raw materials for the chemical industry. About 90 percent of this area could be used to produce starch and vegetable oils and fats for the home market.

The area required by the energy sector (heating, electricity, and fuels) totals between 2 and 3 million hectares. Initially, by the year 2006, up to one million hectares are likely to be planted with energy crops. Biomass of grasses, reeds, straw, timber residues, etc. can be used primarily as a solid fuel for decentralized heat supplies in rural areas, being locally available and having low transport costs and a high material density. In rural communities it could be used to heat hospitals and swimming pools, for example. The Federal Research Ministry is funding 14 such pilot schemes in the new laender and six more in the original federal.

With an eye to the profitability and market readiness of products made from renewable raw materials, CSU [Christian Social Union] Bundestag deputy Albert Dess (Renewable Raw Materials Action Group) has called for greater account to be taken of environmental protection aspects and urged the government to issue directives for their use so that pollution can be reduced more quickly. Dess goes on to say: "The Bavarian Water Research Institute has examined the biodegradability and ecotoxicity of 13 lubricants and hydraulic fluids made from vegetable oil, three made from synthetic oil, and another three from mineral oil. With one exception, the vegetable oil products had broken down by, on average, as much as 81 percent and after three weeks by an average of 93 percent, within an 84 to 100 percent range. At 22 to 25 percent, the mineral oil products tested proved very hard to break down. The synthetic lubricants were even less biodegradable, at 13 to 19 percent."

The test assessed the ecotoxicity of the products by their toxic effect on fish, water fleas, luminescent bacteria, and fish cell cultures. Dess says: "Most of the vegetable oil-based lubricants tested did not prove highly toxic. They were classified as slightly to moderately toxic. But with two exceptions the synthetic and mineral oil products showed strong to very strong toxic effects.

"The ecotoxicity of the vegetable oils depends very much on the type of additives used. Products with low toxicity are already available and further improvements are in sight (Aachen College of Technology additives package)."

The agricultural expert sums up: "People who still accuse agriculture of pure self-interest in its commitment to renewable raw materials should finally accept that impartial experimental findings showing clear environmental advantages cannot simply be ignored. In a few years' time, market realities will prove them wrong."

Support From Scientists

Addressing the Bundestag Environment Committee on the EC proposal to introduce tax concessions for "green" fuel, Professor Dambroth of the Federal Agricultural Research Institute in Braunschweig also said that, despite claims to the contrary, the environment would not suffer as a result of using vegetable oils as fuels. There were [he said] no problems in making a proportion of fuel from plants and using it rationally, e.g., in shipping; renewable raw materials could be cultivated for energy purposes in such a way as not to damage the ecosystems.

Dr. Klaus Scharmer of the Society for Development Technology explained to the environment policymakers in Bonn the positive carbon dioxide balance of "green" diesel. "Green diesel did not pollute water, and the emissions were within the prescribed limits in all cases." Even the phosphorus

content of green diesel was low. Heidelberg scientist Dr. Reinhardt explained the advantages of rape oil as a source of energy. Prof. Dambroth pointed out that a rational crop rotation scheme could avoid yield losses and included gold of pleasure and sunflowers among the top-ranking oil seeds.

Bonn would like to cut the tax on green fuel far enough (to not more than 10 percent of the mineral oil tax rate) for the cost of producing green fuel to be competitive with gasoline and diesel on the market.

Research Minister Heinz Riesenhuber and Development Aid Minister Carl-Dieter Spranger are also making greater efforts to promote renewable energies. At a joint press conference in Bonn, the ministers stated: "The energy requirement in the developing countries will have grown 65 percent by the year 2000. About 2.8 billion people (55 percent of the world's population) have no central energy supply. They have to rely on the 'poor man's fuel'; biomass (wood and charcoal). The demand for wood is growing at the same rate as the population, and the ecological problems associated with felling and burning are growing at the same time."

Improving Living Conditions

They went on to say that the living conditions of poor populations could be improved at no cost to the environment by making wide use of locally available renewable energy sources such as the sun, wind, water, and biomass. Bonn's Development Aid Ministry had already provided a total of DM450 million for technical cooperation for these purposes. A further DM2.4 billion had gone to developing countries as financial aid for the use of renewable energies. There were currently 15,000 photovoltaic water pumps (2,000 being added every year), and 100,000 small wind units in Mongolia (China) alone providing renewable energy. Between 1974 and 1993 Bonn had allocated a total of about DM4 billion for renewable energy sources overall.

Conservationists' Reservations

93MI0359B Wuerzburg UMWELTMAGAZIN in German No 1/2, Jan/Feb 93 p 37

[Text] According to the Nature Conservation Association (BN), the intensive cultivation of renewable raw materials does more harm than good. "Energy from the field is intended to give farmers a new source of income, cut farm surpluses, and reduce pollution. But energy balances show the opposite," said BN Chairman for northern Bavaria Hubert Weiger.

For example, three-quarters of a liter of mineral oil would be required and vast quantities of fertilizers used to produce one liter of rape oil. On the other hand, there were positive energy balances for biogas production and the burning of brushwood [Schwachholz]. The BN spokesman critized the fact that hardly any support was being given to such projects at present, unlike the "insane cultivation of rapeseed."

Biogas, which can be obtained from organic waste and slurry, and brushwood, which was hardly exploited any more in the forests, did not have to be specially grown, unlike the "energy from the field." Consequently, the production process generated no pollutants, BN energy spokesman Peter Selsam said. While at least some local authorities were already converting the biological waste they collected into biogas, slurry was pointlessly being spread on the fields "to the detriment of the environment."

The reason was that Bavarian farmers received hardly any subsidy for the "fermentation towers" that were needed and which cost about DM120,000 for 40 head of cattle. Things were very different, Selsam said, for renewable raw materials: 44 percent of the DM14.2 million authorized by the Bavarian Agriculture Ministry for 1991 had been spent on energy crops.

Germany: Bayer Builds Chemical Residue Incinerator

93MI0360 Wuerzburg UMWELTMAGAZIN in German No 1-2, Jan-Feb 93 pp 42, 44

[Text] The laying of the foundation stone for Bayer AG's Dormagen residue incinerator (RVAD) in early October last year was described by North Rhine-Westphalia's Environment Minister Klaus Matthiesen as "another milestone on the road towards ecological waste management." This large industrial plant, costing 200 million German marks [DM] and the most modern of its kind, will come on stream in stages, starting in the fall of 1994.

According to Bayer AG board member Dr. Dieter Becher, the new hazardous waste incinerator will have a capacity of 45,000 tonnes a year. It uses proven rotary kiln technology and is able to incinerate 300 tonnes of hospital waste a year, 40,000 m^3/h polluted exhaust air, and around 5,000 tonnes highly polluted sewage a year from the Neuss district, Dr. Becher said.

Incineration will take place at temperatures in excess of 900°C. At these temperatures, combustion residues take the form of glassy inert slags (about 7,000 t/a), which will be placed on the Dormagen dump as road building material. Ash produced in the convection section will be extracted via wet ash removers and fed into effluent treatment system.

The flue gases given off by the rotary kiln will be completely burned off in a secondary combustion chamber at temperatures up to 1200°C. After the heat has been recovered in a waste heat boiler and the material cooled to 70°C, chlorinated hydrocarbons, hydrogen fluoride, sulfur dioxide, and dust are removed in a rotary scrubber. Fine dust is removed by electrostatic gas precipitation.

The requisite limit of 0.1 ng/m^3 dioxin as the toxicity equivalent (TE) will be achieved in the planned Dormagen incinerator using the newly developed SCR process tested in a pilot plant in Leverkusen in recent years. SCR stands for "selective catalytic reduction," a dry flue glass cleaning process in which metered quantities of ammonia are added as a reduction agent and the gas mixture is then fed through catalyzers if, for instance, the $Ti0_2/V_20_5$-based type.

The new Dormagen plant will also satisfy all the other emission limits that the 17th Federal Anti-Pollution Order will in future require for incinerators: an average daily organic carbon dust and hydrochloric gas emission of less than 10 mg/m^3 and an NO_x emission of less than 200 mg/m^3, to mention only the most important.

Finally, effluent passes through precipitation and flocculation stages before reaching the biological clarification plant.

The new incinerator will probably employ 54 people. It will be operated jointly with Bayer AG's other works.

German Firm Develops Electrostatic Plastics Sorting System

93MI0361 Wuerzburg UMWELTMAGAZIN in German No 1-2, Jan-Feb 93 pp 50, 53

[Article by Dieter Mueller: "Separation by Friction"]

[Excerpt] [Passage omitted] Kali und Salz [Potash and Salt] Disposal GmbH (K&S), founded at the end of 1991, has developed a new way of separating assorted plastics that can be used for both industrial residues and household packaging waste. The electrostatic treatment process (EST), which has now been patented, makes use of the fact that substances acquire opposing electric charges from friction, thus making it possible to sort them in an electrical field in a second stage. The remarkable thing about the EST process is that plastics of the same density, like polyvinyl chloride (PVC) and polyethylene terephthalate (PET), or polyethylene (PE) and polypropylene (PP) can be sorted almost completely.

The methods used to sort mixed plastics in the past, such as hydrocyclone technology or the sink-float process, which take advantage of the material's specific gravity, are normally only capable of sorting very roughly into the polyolefin fractions (mainly PE and PP) and heavy plastics such as PVC, PET, and the like, K&S Disposal's sales manager, Kurt Harbodt, is certain that "electrostatic sorting is a major process step not, or only very inadequately, offered by other sorting techniques."

Practical Viability to Be Tested

In order to demonstrate the practical viability of the process, K&S is investing around 15 million German marks [DM] over the next two years in building a large pilot plant in Lehrte, near Hannover, that will have an initial working capacity of 10,000 tonnes a year mixed and dirty plastic waste. It will combine the EST process with density sorting techniques to sort mixed plastic waste, for example from the Dual System, automatically and cheaply into largely distinct categories.

So far, the EST process, which has for decades been the established method for the dry separation of raw potassic salt, has only been tried in a Potassium Research Institute pilot plant in Heringen with a throughput of 100 kg/h. Nevertheless, the results are obvious. For example, used disposable syringes from a hospital collection were processed. The syringe plunger was made of PE and the cylinder of PP. From an initial 50:50 mixture, 97.1 percent purity was achieved for PE and 98.9 percent for PP in the first stage. This can be improved still further in a second run, plastics sorting project leader Dr. Rainer Werthmann said in an interview. And, according to Kurt Harbodt, the investment and operating costs are comparable with conventional processing techniques, while output and added value are significantly better.

The EST process uses the plastics' different triboelectric (frictional electric) charges to sort them. The intensity of the opposing charges is heavily dependent on how the materials have been pretreated. "The parameters used are, for example, the relative humidity and the type of conditioners. These are surfactants that are added in parts per million," research and development chief Dr. Ingo Stahl explains. The particles (up to 8 mm) thus treated can then be deflected apart in a high-voltage (120,000 V) field in the free fall separator developed by K&S, and thus separated into fractions. The small, as yet unseparated, residual fraction goes through the process again. However, the process is made more difficult by dirt and various plastics additives such as softeners and the like. Here K&S drew on the technology and know-how acquired over 20 successful years of processing potassium salts.

In view of the 800,000 tonnes or so of plastic retail packaging from dual system collections that will have to be processed from 1995, it is a race against time for everyone involved with plastics processing. K&S's directors see their process as a complementary measure for use in addition to existing technologies and chemical recycling, which is still at the trial stage, if the quantity problem is to be overcome at all. But in this case, Kurt Harbodt adds, the EST process is an important component for removing PVC from existing bulk flows in all processing technologies. [passage omitted]

FACTORY AUTOMATION, ROBOTICS

Automated Production of Fiber-Reinforced Plastics Researched

93WS0196B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 17 Dec 92 p 8

[Article by "sel.": "Fiber-Reinforced Plastics Becoming More Competitive With Automated Fabrication Processes. Fraunhofer Institute Developing a Flexible Manufacturing Center for Fabrication of Fiber-Reinforced Thermosetting Plastics and Thermoplastics"]

[Text] Aachen—The industrial use of fiber-reinforced materials depends strongly on the productivity and the degree of automation of the manufacturing facilities. A flexible manufacturing center for the fabrication of fiber-reinforced thermosetting plastics and thermoplastics was introduced recently by the Fraunhofer Institute for Manufacturing Technology (IPT). Dr. Manfred Weck, a professor, and Graduate Engineer Huemmler in this connection drew attention to the fact that difficulties in the introduction of fiber-reinforced technology can be surmounted only by systematic automation.

For instance, filament fiber-reinforced plastics that are fabricated on modern NC machines in wrapping or tape-application processes are being used to an increasing extent for highly-stressed primary structures. The time-consuming fabrication represents a substantial cost factor here. Conventional materials like steel, cast iron and aluminum are being manufactured with a high degree of automation in almost every sector. Because the fabrication of fiber-reinforced materials is substantially more complicated, a great effort has to be made in order to automate the existing fabrication processes for them to become competitive with conventional materials.

While in the past raw materials and the figuring out and developing of design principles were to the fore, the automation of fabrication processes is still in its beginnings. It is precisely for complex highly integrated components that the wrapping and tape-application processes offer the possibility of attaining a high degree of automation. Improved machine technology and the manufacturing systems' simpler handling are to be aimed at for this purpose.

That is why a flexible manufacturing system for the fabrication of thermosetting plastics and thermoplastics was developed on the basis of a cartesian coordinate gantry robot

within the subproject of special research field 332. This manufacturing center, whose total working space is used by two process units having an identical range of functions, is designed so that two autonomous robots are at the disposal of a single base. The very flexible and simultaneous production of components in the wrapping and tape-application process is possible in this way.

In its basic configuration each working unit has over six NC axes at its disposal, where three have translational kinematics and three rotational. Fabrication devices like fiber eyelets and tape appliers can be positioned and oriented at random in the cartesian space by means of these six axes. Both working units are each controlled by an industrial robot controller of the Sirotec RCM II D type.

Both sets of axes are equipped with absolute measuring systems. New referencing after a disturbance-caused abnormal termination of the program during the fabrication process is unnecessary because of this. Sensor technology based on the reflected glare principle prevents collision between the units.

A numerically controlled wrapping spindle was integrated into the first station at the Fraunhofer Institute for Manufacturing Technology for the wrapping process. A second NC spindle drives the balling carriage, which holds a maximum of six fiber bobbins. In this way it is possible, they say, to feed the fibers to the fiber eyelet with very little reorientation of the fibers.

A component manipulator was integrated into the second station, with which cores can be covered all around and very complicated wrapping operations can be performed. The component manipulator has two continuously turning NC spindles that are at right angles to one another. Both eyelets are mechanically decoupled and can be moved in synchronism to the six axes of the process unit.

A tool magazine integrated into the flexible manufacturing center holds up to eight effectors. Fiber eyelets, application heads and processing tools can be changed and replaced under program control. A safety switch prevents operation of the trip mechanism if the effector is inside the magazine.

Component parts up to one meter in diameter and 2.5 meters long are cured at a maximum of 250°C in the curing furnace. The autoclave can be loaded with parts 1.5 meters in diameter and two meters long. Parts can be cured at a maximum of 400°C under the action of pressure.

The controller for the autoclave and curing furnace as well as the adaptive controller for the robot have intelligent interfaces for the exchange of process data with external computers. By means of a DAE (Distributed Automation Edition) system specially developed for the flexible manufacturing center, the process data from the curing furnace and autoclave, as well as the robot's status, can be acquired, interpreted and visualized on an external computer.

The automation of all preparation and ancillary activities is also part of the continuous automation of the wrapping process. The goal of the development work was to determine and to remedy all the weak points of the wrapping process and by so doing to increase the speed, which is limited for the most part by the impregnation of the roving. An interference-immune system is the basic prerequisite for automated wrapping.

The most frequent interference occurs when the fiber is being guided between pull-off of the fiber from the bobbin until it is wound onto the core. Abrasion and breaking of the roving occur because of forced rubbing of the fibers against the reorientation and guide elements. This does not come about suddenly. Rather, individual filaments of the roving tear and because of this interfere with guidance of the fiber. The roving itself becomes thinner and thinner until it tears because of tension on the fiber.

Rubbing against guide areas can be observed both at stationary guide elements at resin strippers and at rotating guides as at the guide rollers of the impregnating bath. For this reason the wrapping unit was further developed as follows: The entire balling carriage was numerically controlled so that it travels along with the fiber eyelet and thus reduces reorientation of the fiber.

In addition all rotating metal rollers of the impregnating bath were replaced with Teflon rollers, which results in reduced abrasion. Abrasion because of varying fiber tension is likewise a cause of interference. With complicated wrapping geometries it is useful to use a compensating-arm measuring system that measures deviations compared to a set fiber tension and controls a brake motor in order thus to keep the fiber tension constant.

By means of brake motor control, parts can also be wound for which the roving is drawn back and reversal of the direction of rotation of the roving bobbin is possible with this. Besides the sensing and remedying of interference influences, equipping the wrapping unit, tying down the fibers and cutting them off are important for automatic operation. Loading work like equipping the wrapping unit with a new core can be performed by means of a gripping tool that is flange mounted on the robot's hand. All engaging operations like engaging the three-jaw chuck and the spindle sleeve can be performed by the robot controller for this purpose.

Special machine components developed for fiber-reinforced technology are necessary for tying down and cutting off the fibers. The fibers are tied down by means of a pneumatically operated lever mechanism with which the loose fiber ends are pressed onto the core being wound and the lever mechanism rotates along with the core. The work-locating fixture can be released again after several wrapping turns.

The system's productivity is influenced decisively by the wrapping speed, which is in turn influenced by the maximum speed in impregnating the roving. In the wrapping process customary today the fiber pull-off speed is limited to 0.5 to 1 meter per second because of the danger of foaming in the resin bath. The roving is evacuated by the so-called vacuum impregnation process before impregnation. This results in a faster impregnation process. Pull-off speeds of up to five meters per second can be attained.

The "Wrapping" program system was created for the efficient and user-friendly generation of robot programs. Various algorithms were integrated into this program system under a common user interface for the direct generation of robot controller programs for the wrapping of cylindrical, curved, tubular and board-shaped parts. These programs are transferred to the robot controller through a local area network. Off-line programming is possible in this way. Uninterrupted fabrication without manual intervention is possible by means of this system.

German Institute Studies Lighter Materials, Flexible Work Processes

93WS0196C Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 17 Dec 92 p 8

[Article by "sel.": "Metal Working: Product Improvements With Lightweight Construction and Flexible Working Processes. RWTH Institute Trying to Find New Possibilities, to Roll Expediently Sheets of Variable Thickness"]

[Text] Aachen—Metal working too is increasingly having to face requirements for products that are lightweight, create little waste in manufacture and can be refed to the materials cycle as completely as possible after use without causing problems. The Institute for Ductile Forming (IBF) of Rhine-Westphalian Technical College (RWTH) headed by Dr. Reiner Kopp, a professor, has become engaged in work with these considerations.

The development of lightweight designs, hence, the fabrication of semiproducts and component parts having especially high unit strength or rigidity, constitutes an emphasis. In addition it is a question of flexible working processes that are based on the computer-controlled use of simpler tools that can be used for a broad range of products. An important aid here is computerized simulation, by means of which the material's behavior can be simulated increasingly more realistically.

In aircraft construction one can expect that a one-percent saving in weight when the aircraft has a useful life of 20 years will result in a fuel savings of 600 tons. The pressure to save weight and accordingly toward lightweight construction is showing itself in motor vehicle making too. Lightweight construction can be attained if the parts show especially high strength and rigidity relative to their density.

For sheet metal this has been attained for a long time by means of various sheet working processes. The stiffening effect of a stiffening corrugation having a varied geometry shows that even slight distortions can produce stiffness gains especially against a normal load.

However the production of smoother distortions by means of deep drawing is rather problematic. Shot-peening forming, which is being researched theoretically and experimentally today, offers an alternative here. By means of definite quantitatively regulated shot peening the geometry of flat plates, tubes and compound structures can be altered so that they demonstrate greater resistance to bulging and vibration. The Institute for Ductile Forming has received a new shot peening unit by means of which light-construction products can be developed on a scale of one to one. It is a question of products for aerospace and of saucer-shaped lightweight structures for traffic engineering and building construction. A team of representatives of the Aachener Raum [Aachen Space] Associated Company (BGA), the Center for Automotive Engineering (ACA) and IBF is now looking after the sale of new products together with interests from industry.

Hollow structures represent an additional option for saving weight. In the lightweight construction developed at the institute, which was developed together with the Institute for Welding Technology, it is a question of a sandwich structure that can be fabricated as a semiproduct and, in contrast to the structures known from aviation, is plastically deformable.

The possible weight saving depends on the design, the ratio of hollow space to the total volume and on the part's specifications. For some time an attempt has been made to save on weight by the use of various sheet gauges. Sheets of various thicknesses are welded together by means of lasers and then deep drawn.

At present Kopp is pursuing the idea further, of rolling sheets of variable thickness. This could result in various advantages: Welding could be omitted, thickness flaws could be avoided, and better utilization of the material would be possible. The pressure toward shorter product development times is resulting in new production processes that make do without long preparation time, for toolmaking for example.

This is becoming more and more clear as the result of the much shorter innovation times for a new passenger car model in Japan. The flexibility of working processes represents an important contribution in this connection. Flexible manufacturing processes are distinguished mainly by the low tool commitment of the finished product, hence, the use of universally usable tools. Added to this are the breakup of production linking, computer-assisted material flow control and quicker tool changing.

The Institute for Ductile Forming of the Aachen technical college has developed some typical flexible metal working processes. They include the partial forging of plate-shaped parts, the robot-guided forging of shaped parts, the rolling of sheets having variable wall thicknesses, and sheet working by means of shot peening, lasers and induction heating.

Various groups of processes are emerging in the forging of bar-shaped and plate-shaped products. Four-hammer machines are gaining in importance for bar-shaped long products, especially for machining sensitive new alloys. Three groups of processes present themselves for the fabrication of plate-shaped integrated parts. The first two require a type of press that can position the elementary die very precisely and can guarantee a large number of strokes.

The design of a press of this kind having an elementary-die magazine has been completed in cooperation with industry. The process's principle was implemented on IBF's open-die forging press. Approximately 20 parts have been fabricated by means of a tool set made up of elementary dies. These parts result in a 45-percent saving of materials as compared with purely cut parts.

In the quest for processes with which it is possible to come to "near-net-shape" parts without high tool expense, the use of robots presents itself. There are already solutions for the forging of long products. The use of a robot in the forging of any shaped parts whatever is being developed and tested in cooperation with the Laboratory for Machine Tools (WZL) at the technical college in Aachen. The first forgings from plasticine have been made completely automatically. The next step is coupling a KUKA robot with IBF's process-computer-aided hydraulic press. The investigations are for controlling the robot during the forging of random shaped parts and the development of a special coupling between the gripper and robot's arm.

IBF is developing in close cooperation with industry and has subsidized through the Ministry for Business, Small and Medium-Sized Enterprises and Technology in the Land of

North Rhine-Westphalia the double-roller process for the fabrication of strips and the casting and forging process combination.

Process control in the double-roller process can be characterized as stable today, Kopp emphasizes. The total crucible contents of 100 kilograms of molten steel are reportedly being poured regularly. This entails coils up to 130 meters long according to current strip thicknesses. The control principle, implemented from the beginning of the process on, by means of which the roller clearance and strip casting force can be held constant, proved to be an advantage here. The strip casting force is the controlled variable here, and the rate is the manipulated variable.

After the strip geometry was able to be improved substantially during the series of experiments, it is possible today to produce strips having neater edge development without so-called hammered edges. However, further development work in the area of sealing the liquid pool is still necessary for exact consistency.

NUCLEAR R&D

France: CEA Focuses on Nuclear Research

93WS0274D Paris L'USINE NOUVELLE in French 28 Jan 93 pp 32-35

[Article by Odile Esposito: "CEA More Nuclear Than Ever"]

[Text] *The CEA [Atomic Energy Commission] is focusing today on nuclear waste, fuels, and reactors, but also on safety, including the behavior of nuclear power plant installations in the event of earthquakes.*

The British government is withdrawing from the EFR [European Fast Reactor] project, which is to provide the successor to the Super-Phenix. The Germans are depriving Siemens of all subsidies in connection with nuclear research. The Americans are transferring the operation of their uranium-enrichment plants, and research in this field, to a private company. Are economies the concern? Does this trend mark a logical opening of generalized access to an activity that has become completely industrial? In any case, to judge from the evidence, atomic energy research is no longer one of the priorities of the Western governments.

In this climate of disaffection, however, France is the exception. This year, the Atomic Energy Commission [CEA] will receive a subsidy equal to that of 1992. And its nuclear orientation is being affirmed with added emphasis, while those of its activities having only a distant relationship with the atom are being mercilessly eliminated. Thus, this year, the CEA is abandoning its civil robotics activity, whose major work has been the subway cleaning robot.

Exit the exotic! Priority to the nuclear. Why? The presently-installed pool of nuclear plants operates rather correctly. And it largely satisfies France's projected needs to the end of the decade. But there is no unanimity as to its economic competitiveness. Much remains to be done to reduce the cost of the fuel, lengthen its service life, and even improve its form. The operation and safety of the plants can still be optimized. And above all, the generation of nuclear energy is still burdened, as by a millstone, with the cumbersome problem of nuclear waste.

Plutonium stocks are increasing dangerously. On average, the French pool of installed plants produces some 10 tons of waste annually, and only a very tiny portion of this waste can be reused in the plants themselves and in the Super-Phenix. "Plutonium, like the language of Aesop, can conceal both the best and the worst," says Research Minister Hubert Curien, in his report on the incineration of nuclear waste in Super-Phenix, which has recently been released to the public. Its elimination at all stages recurs like a leitmotiv throughout all the research programs conducted by the CEA.

Upstream of these programs is the fuel element. Consisting of millions of enriched-uranium pellets stacked in the form of "pencils" [rods] and surrounded by a leakproof sheath, it has a service life of only three or four years inside a reactor before having to be replaced by a new fuel element. "These renewals enable the periodic introduction of the advances made in research and development," says Jean-Yves Barre, manager of the fuel cycle. Research is centered mainly on the energy yield of the rods.

"The fuels of the next generation of nuclear plants are expected to last five years in the reactor, in lieu of today's four years, and of the three years of some 10 years ago," says Jacques Bouchard, manager of nuclear reactors. This lengthening of the duration of fuel elements inside the reactor will increase their yield to 60,000 megawatt-days per ton, versus today's 45,000, and the 33,000 of the first reactors. And the researchers envision achieving 100,000 megawatt-days per ton... How? The many tests run on fuels in the Osiris research reactor, installed at the Saclay site, have enabled studies of the behavior of the rods in cases of prolonged radiation. These tests have shown that one of the principal obstacles to lengthy duration of the rods in reactors has stemmed from the sheath that surrounds the oxide pellets. This sheath exhibits a very high sensitivity to corrosion, and tests are being conducted on new alloys at a fuel-manufacturing test installation at Cadarache (Bouches-du-Rhone). In the more distant future, the fuel experts plan to use a more highly enriched but not too expensive uranium... A difficult equation to solve, since enriching is a complex operation that consumes a great deal of energy (see box p 34 [below]). This is why researchers are counting heavily on the laser.

The fuel of the future could also take on a different form. "With attainment of the desired five-year life of the rod in the reactor, uranium oxide will undoubtedly have reached its performance limits," says Jacques Bouchard. Tests are therefore being conducted on composite fuels inserted in metallic and ceramic matrices.

Fuels research can nevertheless not escape concern for elimination of the plutonium and improved reprocessing of nuclear waste. Mox fuel, which mixes uranium oxide pellets with plutonium oxide pellets, is now operational in five of the EdF [French Electric Power Company] network's nuclear plants. But the performance of these plants has yet to be optimized from the economic standpoint, at the production level and at that of the implantation of this type of fuel in the core of the reactors.

The CEA's researchers are also keeping a watchful eye on Super-Phenix. If the Creys-Malville (Isere) plant is used to burn nuclear waste, as the Hubert Curien report recommends, they will have to quickly start putting together the fuel charge for this reactor. At the present time, Super-Phenix is designed to produce more plutonium than it consumes. This

breeding is made possible by the use of a uranium blanket that captures the neutrons that escape from the core and is thus transformed into plutonium. Elimination of this blanket for future charges of fuel, based on a new study of the core assembly, is expected to permit attainment of equilibrium at a breeding ratio of 0.8. Super-Phenix would then contribute to the destruction of 200 kilograms of plutonium annually, or 1 percent of the plutonium produced annually by the total French installed nuclear power generating capacity. A tiny step forward...

Plants Hard To Modify

Fuels lend themselves rather well to regular improvements, but the plants themselves are harder to modify. The CEA nonetheless maintains a significant research program on reactors. Why? "Today, there are 420 nuclear generators of electrical energy in service throughout the world," says Jacques Bouchard. "We need to draw lessons from that mass of experience, so as to further improve safety. For example, we must reduce the risk of meltdown, which today is one per thousand years, and ensure the confinement of radioactive materials in case of accident." Research conducted on the Phebus reactor (see box p 35 [below]) will assist in validating or modifying procedures for reacting to any potential accident.

Much has yet to be done also on the study of the behavior of nuclear plants in case of an earthquake. For the past several years, the Tamaris de Saclay (Essonne) laboratory has been conducting vibration tests on the essential components of the plants and on the principal safety devices and systems (electrical equipment bays, emergency injection pumps, etc.). These tests have made it possible to draw up a very severe set of specifications for the construction of the most recent power generating plants.

All the problems have not yet been resolved, however. "The effects of heavy vibrations on a dynamic system in which large quantities of fluids circulate are still not perfectly known," says Jacques Bouchard. Besides, there is always a possibility that the engineers may have to face new problems. Premature aging of the piping systems is a case in point.

The piping in nuclear electric power plants is equipped with numerous supports that hold it in place in the event of an earthquake. Unfortunately, these supports are believed to cause abnormal fatigue of the piping. "We are therefore conducting tests to determine if some of these supports can be eliminated," says Philippe Jamet, head of the Tamaris laboratory.

Improvement of the fuel, safety studies, vibration tests: All of this research will, of course, help to improve the reactors of the future. The French and Germans are currently preparing the next generation of pressurized water reactors, baptized the EPR [European Pressurized Reactor]. If Germany decides to continue along the nuclear road, the firstborn of this cooperation can be expected to be brought forth around 1998. "This reactor is to integrate all the advances being made in the area of safety and fuel management," says Jacques Bouchard. "We thus have five more years in which to work with EdF and Framatome. That is a long time, but also a very short one in which to evolve important technologies."

To prepare the future beyond the year 2000, the CEA is pursuing its research on one of its pet projects: fast reactors, as successors to Super-Phenix. But the end purpose has changed. "We have worked a lot, in the past, on the creation of plutonium," says Jacques Bouchard. "Today, we are seeking to capitalize on the flexibility of this type of plant. A reactor designed to operate on the basis of plutonium is the best suited to incinerate this plutonium and other by-products such as americium and neptunium." Breeding is no longer on the agenda. Interest has shifted to fast neutrons. Owing to their energy and high flux, they can be utilized to incinerate nuclear waste.

The CEA is therefore participating in the EFR [European Fast Reactor] program, from which the British have recently withdrawn. The objectives of this program are simple, but ambitious. As successor to Super-Phenix, it will have to be more compact, and half as ravenous a steel guzzler. Specifications also call for the upgrading of safety. In case of accident, for example, the core's residual power must be able to be evacuated by natural convection. This requirement will necessitate more-massive installations. The work of the researchers thus consists of finding the best possible compromise among all these constraints.

Does the British withdrawal threaten to upset the program? "Great Britain was financing 20 percent of the research work, and was responsible for specific portions of the work," says Jacques Bouchard. "It headed the mechanical engineering of the core and the study of sodium/water reactions. Its decision therefore poses a problem." Germany, the third partner in the project, has not reacted, for the moment. As a proponent of storing irradiate fuels rather than reprocessing them, it perhaps accords a lower priority to the EFR program than do the French. In the event of defection of both these partners, the CEA will not hesitate to knock on the door of the Americans or the Japanese, both of whom are pursuing the same objective: the use of fast reactors to burn the maximum possible waste.

System's Achilles Heel: Waste

Wretched waste! Thirty years after the start of the nuclear program, it still constitutes the Achilles heel of the system... and one of the CEA's principal sources of worry. In one year of normal operation, an average 1,000-megawatt nuclear energy plant produces 20 tons of depleted uranium, 260 kilograms of plutonium, 21 kilograms of by-products—such as neptunium, americium, and curium—known as the actinide series, and 750 kilograms of fission products (essentially iodine and cesium).

The reprocessing done at the Cap de la Hague plant consists of cutting up the fuel elements into small pieces, dissolving them in a suitable solvent, then separating out the uranium and plutonium from this voluminous, radioactive mass. The uranium is re-enriched and used in the plants. The plutonium is used in the manufacture of mox fuel and to feed Super-Phenix. But these uses are not sufficient to dispose of the stocks, which are growing more and more voluminous. The actinide series and fission products are sorted and processed in accordance with the potential duration of their radioactive toxicity.

Thus far, the option on which government planning is based is definitive storage of the waste with the longest radioactive life, in deep geological layers. But this option is not, and is indeed far from being, to the liking of the world as a whole. An element such as neptunium, for example, has a half-life of two million years. This means that it will take two million

years, from the time it leaves the reactor, for the element to lose just half of its radioactivity. And several tens of millions of years for it to become totally innocuous. These time scales are frightening. No one can undertake to guarantee the safety of such deposits for durations of that magnitude.

The concerns of public opinion have gradually nudged the French government authorities into launching new research efforts on the reprocessing of this waste. The objective of the so-called SPIN project is simple: Reduce the volume and radioactivity of those long half-life by-products that would be buried deep in the earth's layers.

How? Two complementary methods are being considered. First, the sorting operation at the Cap de la Hague plant must be further upgraded to include the separation of long half-life by-products such as neptunium and americium.

At the same time, researchers must study possible ways of destroying these elements. Being considered in this regard is their introduction in very small quantities into the fuel of conventional plants (possibly the next-generation EPR), where the neutron bombardment to which they would be subjected could transmute them into less hazardous elements.

Long-Term Projects

Tests in this regard are presently being run in the Osiris reactor. But the CEA's experts are counting mainly on the fast reactors: Phenix, Super-Phenix, and their potential successors. Research efforts are also being devoted to the possibility of utilizing particle accelerators to perform this type of incineration.

All of these programs are long-term, exacting projects. The SPIN program will provide its initial conclusions within some 15 years. The CEA's experts do not expect to be able to industrialize these destructive processes for another 30 to 40 years. That is a long time, to be sure, when one considers that the stocks of plutonium and long-life radioactive waste will continue accumulating until then! But France has no choice. It has plunged headlong into an ambitious nuclear program. And it must now resolve satisfactorily all the concomitant difficulties engendered by this choice...

[Box p 34]:

A More-Enriched But Less-Costly Uranium

Enrichment of the uranium, a strategic but costly stage in the reactor fuel cycle, has always had a place of its own in nuclear technology. In principle, this operation consists of transforming natural uranium to increase its proportion of uranium 235—the sole uranium isotope capable of sustaining energy-producing chain reactions—from 0.7 percent to 3 or 4 percent. Current methods—the gaseous diffusion and gas centrifuge processes—depend on the very small difference in mass between the two varieties of uranium (235 and 238). As a result, enrichment installations are massive in scale, and gigantic energy-guzzlers. In the Eurodif plant, for example, which is powered by three nuclear plants, enriched uranium is obtained only after 1,400 successive stages, an operation that costs the consumer an additional 1.8 centimes per kilowatt hour.

To reduce the bill, researchers are counting on a different so-called Silva process. The uranium is vaporized, then irradiated by a laser whose light is tuned to excite the uranium 235 isotope. Potentially, this method can consume 20 times less energy than current methods, and can be applied in modular installations much more compact than Eurodif. Using this method, the CEA has succeeded in producing a few grams of enriched uranium. The Americans, in the lead by five or six years, are at the kilogram stage.

For technical and economic reasons, however, the industrialization of this method is not foreseen before the year 2010. And the situation is being adversely affected by the nuclear-arms dismantlement program. Energy shortage is no longer an immediate agenda issue, and Silva must bide its time.

[Box p 35]:

900 Million French Francs To Simulate Accidents

How can a serious nuclear accident's effects on human beings and on the environment be anticipated? One can hardly be content with just the observations stemming from Three Mile Island in 1979 and Chernobyl in 1986. And obviously, a catastrophe cannot be provoked in order to study its effects! The scientists responsible for studying nuclear safety thus find themselves faced with a dilemma. Their sole recourse is computer modeling. Several complex programs have been developed by electronics experts and research centers worldwide. But they are not enough. These programs are written on the basis of a juxtaposition of equations describing the behavior of such and such a fluid or such and such a gas. But do they take into account completely the physical and chemical interactions that can take place among the different elements? Do they not overlook an important phenomenon? No one would stake his or her life on it!

Tests are essential. Since 1988, the CEA has been preparing a series of tests to be run using the Phebus reactor at Cadarache, in order to study the behavior of fission products in the event of a meltdown. "Iodine and cesium, which is very volatile, are the main products released into the atmosphere," says Philippe Vesseron, manager of the Institute of Nuclear Protection and Safety. "The tests being run on Phebus will enable a verification of the hypotheses developed through modeling, and the validation of the computer operating system and software used."

These tests, which are to continue until 1998, require a very complex preparation. Under no conditions can radioactive by-products be released into the atmosphere or permitted to contaminate Phebus. A highly irradiated fuel element taken from a nuclear reactor and enclosed in a leakproof sheath, will be introduced into Phebus's core. After two to three weeks of additional irradiation, designed to further augment the quantity of fission products produced, this test fuel will be connected to a number of reservoirs and pieces of equipment simulating the primary circuit of a reactor, then heated to a high enough temperature to melt the rods and their sheath. The engineers will then simulate a depressurization, releasing radioactive by-products into a leakproof container. The entire installation will be riddled with sensors that will measure and dissect all the phenomena. The first of the six tests that have been planned will begin in March of this year, and the study of the results will require two years of work. The program as a whole will extend to 1998. Its total cost: 900 million French francs, cofinanced by the EdF (25 percent), the European Economic Community (30 percent), and foreign partners (15 percent divided among Japan, the United States, Korea, and Canada). Safety has no price!

Germany: Fuel Elements for Russian WWER-1000 Reactors Tested

93WS0279B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 19 Feb 93 p 8

[Article: "Karlsruhe's KfK Testing Russian Fuel Elements"]

[Text] Karlsruhe (DPA)—A safety experiment with simulations of fuel elements for Russian nuclear reactors has begun at the Cora pilot plant of the Karlsruhe Nuclear Research Center (KfK). According to a communication from the big research facility, an accident is to be simulated, during which severe damage to the core is caused due to a loss of coolant. In the process, fuel elements of the Russian WWER-1000 pressurized-water reactor type will be subjected to conditions that arise at the beginning of a core meltdown. Scientists from the Kurchatov Institute in Moscow are also participating in the tests.

It was agreed to carry out the tests in August 1990 within the framework of an agreement between the Ministry for Research and the then Soviet State Committee for the Application of Nuclear Energy. According to the Nuclear Research Center, it has already been demonstrated at the Cora pilot plant with pressurized-water reactors of Western construction type that exceeding the limit the reactor was designed for, 1,200°C, does not necessarily have to lead to an uncontrolled core meltdown.

Rather it was shown that the excessive rise in temperature can be brought under control and, despite severe damage to the reactors, they can be gotten into a condition in which they can be cooled. But, in view of other structural materials, these results cannot be applied to the Russian reactors. This makes it necessary to test them on their own.

France: CEA To Resume Operation of Phenix Rapid Reactor

93WS0284B Paris LE MONDE in French 10 Feb 93 p 30

[Text] On Monday, 8 February, the Directorate of Nuclear Installation Safety (DSIN) authorized the Atomic Energy Commission (CEA) to start up the Phenix fast neutron reactor again and operate it for 10 days only. The reactor will run at 350 thermal megawatts, or 65 percent of its nominal power. The government's limited authorization temporarily brings to an end a long down period of just over two years[1], necessitated by the discovery in November, 1992, of a 35-cm flaw in a duct of one of the reactor's three secondary circuits. The flaw raised fears of sodium fires and functional anomalies like those Phenix suffered between between August, 1989, and September, 1990. The experimental supergenerator installed in Marcoule (Gard) is the inspiration for the Superphenix.

Indeed, Phenix experienced sudden drops in its reactivity—brief slowdowns in the nuclear reactions of its core, leading to an immediate shutdown of the machine—four separate times during that period. What caused this rather extraordinary phenomenon? Various scenarios have been floated, including the accidental presence of an argon bubble, measurement aberrations in computer systems disturbed by solar activity or the radar of a nearby airbase, or even a sort of "breathing" of Phenix's core. But all the science of French or foreign experts has been inadequate to reconstruct what happened.

On the other hand, the long investigation showed that all the scenarios floated to explain the drop in reactivity did not result in an offsetting catastrophic jump in reactivity that would lead to runaway nuclear reactions. Reassured though not satisfied, CEA engineers have since loaded up Phenix with new measurement devices and are going to try over the next 10 days to shed some light on the curious string of incidents.

Then the 20-year-old reactor will be shut down again while it awaits a new examination. That health check, says the DSIN, "will determine whether it will begin operating again at full capacity for a long period." The CEA fervently desires such a resumption in operation. Phenix's failure to produce electricity is costing it 150 million French francs a year in lost earnings, and the agency needs the reactor to complete tests involving fuel irradiation and the incineration of long-lived nuclear-waste.

Footnotes

1. But tests at low and zero power were performed beginning in October, 1991.

France's GANIL To Launch Nuclear Detector

93WS0312A Paris AFP SCIENCES in French 11 Feb 93 pp 16-17

[Unattributed article: "New Nuclear-Physics Detector at GANIL [National Major Heavy-Ion Accelerator] in Caen"]

[Text] Paris—A new nuclear physics detector, designed to study "hot nuclei" on the National Major Heavy-Ion Accelerator (GANIL) in Caen, will start its first experiment campaign at the end of the month.

The detector was inaugurated Monday, in the presence of the GANIL director, Mr. Simon Harar; the CEA [Atomic Energy Commission] Director of Material Sciences, Mr. Robert Aymar; and the director of the Nuclear and Particle Physics Institute (IN2P3; part of the CNRS [National Center for Scientific Research]) and former GANIL director, Mr. Claude Detraz.

Started three years ago, the construction of this instrument, INDRA [Nucleus Identification and Enhanced Resolution Detection] cost 15 million French francs [Fr] (included in GANIL budgets), provided in equal amounts by the CNRS and the CEA; it called for the cooperation of some 100 physicists, engineers, and technicians from the CEA-Saclay, the Orsay Nuclear Physics Institute, the GANIL, the Caen Particle Physics Laboratory, and the collaboration of the Orsay Linear Accelerator Laboratory. The INDRA ionization chambers, which are at the core of the facility, were made at the CEA.

A major nuclear physics tool, financed in equal amounts by the CNRS and the CEA, GANIL performed its first experiment in January 1983. The accelerator consists of an ion-injection cyclotron and two cyclotrons with separate power lines, one high-resolution spectrometer, and detectors (ORION, TAPS [Two Arms Photon Spectrometer], INDRA, etc.) to study the reactions generated by heavy-ion (carbon to uranium) collisions.

During such collisions, two nuclei may interpenetrate and temporarily merge into a very-high-energy system in which energy is stored in the form of heat; this is called a "hot

nucleus." This energy, equal to several mega-electonvolts, represents several tens of billions of degrees, i.e. close to the temperatures in the core of supernovas (massive exploding stars) during gravitational collapse.

The cooling of hot nuclei is accompanied by the emission of a large number of nucleons (neutrons and protons) and—a current subject of debate among physicists—the fragmentation of matter (production of light nuclei) or "multifragmentation."

INDRA, which consists of 336 modules comprising a total of 628 detectors, will make it possible to study these phenomena with a precision unequalled so far (as it will cover nearly all the space surrounding the target and identify collision products one by one over a broad dynamic energy range) and to verify the theoretical models used by physicists and astrophysicists to compute the probability of these nuclear reactions.

Currently, the GANIL employs 238 people, including 133 from the IN2P3/CNRS and 91 from the CEA (plus students, Ph.D. students, etc.). Its 1993 budget (labor excluded) amounts to Fr58.5 million, including Fr26 million each from the CNRS and the CEA, and Fr6.5 million from the Basse-Normandie region and as subsidies for the implementation of research. The GANIL is contemplating future investments of Fr100 million or so in a program called "GANIL Plus."

Germany: Doubts Cast Over Future Nuclear Power Production

93MI0345 Bonn DIE WELT in German 16 Feb 93 p 14

[Text] Europe's major power station builder, the Siemens power generating division (KWU) thinks that German expertise in the construction of nuclear power stations will be jeopardized unless plans are initiated in the middle of 1995 for the construction of a new reactor in the Federal Republic. At the annual press conference in Muelheim/Ruhr, KWU chief and Siemens board member Adolf Huettl said: "Without new nuclear power stations in our own country, we shall have no chance on the world market either."

Huettl also thinks that the "Nuclear Power International" (NPI) joint venture with the French company Framatome is at risk. NPI is currently developing the basic engineering for the EPR 1,500-megawatt safety reactor for the Franco-German electricity industry. The transfer to an actual construction project must be made by the middle of 1995. Huettl hopes to receive a building license for 1998.

He bluntly rejected the energy consensus mooted by the electricity companies RWE [Rhine-Westphalia Electricity Works] and Veba [United Electricity and Mining Works Corporation] according to which the construction of new nuclear power stations was only as a "vague option." "Our cooperation with Framatome can go ahead only if there are real prospects for constructing nuclear power stations in Germany in both the medium and the long term," said Huettl.

He is also annoyed about the Land of Hesse's obstructionist licensing practice for the MOX [mixed oxide] fuel element plant in Hanau: It had been idle for over 20 months resulting in a a loss of half a million German marks [DM] per day.

A move away from nuclear power is already unlikely to be a fundamental issue for Siemens KWU. Out of sales worth DM6.6 billion (5 billion) in 1991-1992 (to 30 September), power stations fired by fossil fuels account for DM4.9 (3.1) billion. The remaining nuclear portion relates to servicing and fuel elements. There are only three reactors now in the order book, but 87 (75) stations fired by fossil fuels. This is the sector where KWU intends to promote vigorous growth in the first instance, with a sales target of more than DM7 billion in 1992-1993. Orders are expected to reach DM8.8 billion this year, as against DM8.6 billion in 1992. The 2.4-percent return on investment lies within the Siemens average, but is to be raised to 5 percent. KWU had made a positive contribution to the consolidated result, said Huettl, without mentioning precise figures.

SUPERCONDUCTIVITY

Dresden: Better Refrigeration Devices for Superconductors

93WS0196A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 18 Dec 92 p 8

[Article by "ahv.": "Low-Temperature Refrigerator With Small Split-Stirling Gas Refrigerating Machine. Dresden Scientists Invent New Techniques for Better Use of Superconducting Effects]

[Text] Frankfurt—"Custom-made" refrigeration systems are making the effective use of many components made from high-temperature superconductors possible for the first time, as was reported recently at the VDI [Association of German Engineers] conference on high-temperature superconducting in Potsdam. For example, in high-frequency engineering the high quality of superconducting antennas and filters can first be used practically if long-lived refrigeration systems are available. For example, a transmitter coupling filter for mobile radio should operate static- and maintenance-free for five years. A suitable Stirling refrigerator having the required refrigerating capacity of 250 W at 77 Kelvin presently exists as a prototype of the American Carrier company.

For use in satellites, users want above all miniaturized refrigerating systems. It ultimately depends on the refrigerating machine's weight whether the use of lighter and more compact superconductors to be designed will pay at all.

But users want easy-to-handle refrigerating systems not only in satellite equipment but also for many applications in high-tech equipment or in research. That is why the Dresden Institute for Ventilation and Refrigeration (Bertolt-Brecht-Allee 20, O-8019, Dresden) has developed an especially versatile low-temperature refrigerator that contains a miniaturized split-Stirling gas refrigerating machine from the AEG company.

The refrigerating head is furnished with a removable adapter so that structural elements of the most different shapes can be integrated. In addition the unit works through the standard a.c. network and accordingly can be used practically everywhere.

The Dresden scientists accumulated their first experience long before the discovery of high-temperature superconduction when they were developing refrigerating systems for laser spectroscopy. An additional new development evolved from this work that makes it possible to refrigerate several sensors to different temperatures at the same time.

For this purpose three experiment chambers that can be set independently of one another to a temperature between 80 and 300 Kelvin are linked up with nitrogen-filled cryostats. The specimens can be exchanged at any time here without disturbing the continuous measurements in the other two experiment chambers.

The Dresden scientists are currently developing a completely new technique for the refrigeration of superconducting quantum interference detectors (SQUIDs). These magnetic field sensors are extremely susceptible to interference from electromagnetic secondary effects and vibrations that cannot be avoided in direct coupling with Stirling gas refrigerating machines. Therefore the new system is designed as an indirectly coupled system that is based on the storage of vaporized nitrogen.

Low-temperature refrigeration has found a broad application field above all where there are no conventional alternatives to high-temperature superconducting systems. For example, this applies to biomagnetic measurements in medicine by means of SQUIDs, or for diode lasers (cryoelectronic semiconductors) that are of importance for the measurement of pollutants in environmental engineering.

TELECOMMUNICATIONS

Telekom's Ricke on Strategy, Problems, Investments

93WS0197A Munich TOP-BUSINESS in German Jan 93 Supplement pp 8-12

[Interview with Helmut Ricke, Telekom managing board head, by Brigitte Vogel; place and date not given: "The Broad Path to the Customer. Telekom Head Helmut Ricke on the Billion-Mark Hole in the Cash on Hand, the Future Organization of the Telephone Authority, and Its Chances in International Competition"]

[Text] Germany's Telekom telecommunications concern has experienced how quickly plans have to be upset. That the postal service unleashed its telephone company to free competition was already a hard piece of work in itself. But then when the reunification of Germany happened to come in addition too, and the new federal lands had to be run through with telephone lines as quickly as possible, things swelled to a titanic job.

[Vogel] Mr. Ricke, in a few days you will have been Telekom's chief executive officer for three years. Did you suspect then in 1990 when you started the job what was in store for you?

[Ricke] I was aware from the beginning that this would be no easy job. But events have occurred in the meantime whose impacts were not so foreseeable. The reunification, for instance, which is demanding a historically unparalleled effort of us, that is, to produce out of a hat an up-to-date telecommunications infrastructure in the five new federal lands.

[Vogel] But you surely did not have to begin from zero?

[Ricke] As good as. Nothing had been invested in an area-covering functioning infrastructure for everybody.

[Vogel] What was the second unreckoned event then?

[Ricke] It is basically less an event than a continuous process. Because of competition and technical advances the telecommunications markets are advancing at breakneck speed in the entire world.

[Vogel] But as a quasi-monopolist could you not care less?

[Ricke] By no means. More and more areas are being opened to competition. That is the federal republic's policy and the stated intent at the European level. New competitors are entering the scene. Even in our domestic market, the federal republic, foreign carriers today are approaching our customers with increasingly aggressive advertising strategies.

[Vogel] But you can do that too. It just appears as though Telekom has not yet realized that it as a communications services provider has customers at all.

[Ricke] We have already changed quite a bit here. At the moment we are even adopting a leaner more modern organization. We have begun by way of a first the development of a controlling system that will provide us the data that are absolutely necessary for the management of a company.

[Vogel] The end of governmental accounting?

[Ricke] Yes, an important step. In addition we have in the meantime streamlined our internal logistics and Telekom service. Although on paper for the present—but we are already right in the middle of the changeover.

[Vogel] But whoever comes as a customer to Telekom is still treated as an applicant.

[Ricke] That has changed. We have just concluded the plan for a completely new structure for our organization. Customer orientation is the supreme goal here.

[Vogel] Sounds good. Only, how do you wish to bring so quickly to customer-friendliness this colossus with around 230,000 employees?

[Ricke] In the future we will focus totally on the needs of our various groups of customers. From head to toe, that is, from the managing board to the 122 telecommunications agencies at the scene, we will orient our organization systematically toward the four groups: private customers, business customers, system customers—that is, large concerns having demanding telecommunications networks—and finally the mobile radio clientele.

[Vogel] So in the past for Telekom there was nothing at all for the customers.

[Ricke] Of course there was. But the organization was oriented strictly toward technical-functional criteria. This structure was the right one for the priority responsibility of days past, that is, guaranteeing basic area-wide coverage. Customers' requirements in communication matters are becoming increasingly more complex and individual today, and they also change faster.

[Vogel] Is there not the danger that Telekom will split up?

[Ricke] I do not see that. Although the four customer divisions and the new management divisions are working independently with technical cross-functions and will in the future be responsible for their own performance, nevertheless synergistic collaboration is ensured.

[Vogel] But that just means reduction of the bureaucratic water on the brain not for a long time yet.

[Ricke] I cannot accept the term water on the brain. But it is correct that we have too many hierarchical levels. At present decisions have to go through up to 14 levels to execution. We will reduce these to up to 10 levels depending on the range of responsibilities. Even just about seven hierarchical levels will be necessary for the system customer division. In addition responsibility will be shifted strongly downward to the decision maker on the scene.

[Vogel] Is reorganization a dream of the distant future?

[Ricke] No. The framework has been built, study groups are now clarifying the details, and the heated phase of the changeover begins as of the start of 1993.

[Vogel] Then your personnel are quite ready for the competition?

[Ricke] Do not underestimate our personnel. Basically, the standard is rising with the level of the assignments handled.

[Vogel] But in personnel policy you are chained to the shackles of the public service law.

[Ricke] Of course we move within the framework of the laws. If you are thinking of the promotion mechanisms and compensation structures, I agree with you there, then we run up against the limits with our plan. This is indeed one of the reasons for the public debate concerning converting Telekom and the other postal companies into German stock corporations. But entirely regardless of the privatization debate the Telekom organization has absolutely to become leaner and more streamlined.

[Vogel] The strongest argument for the partial privatization of Telekom, you say, is the acute shortage of equity capital. How much is Telekom short then?

[Ricke] The balance sheet total should climb from 132 billion German marks [DM] at present to probably DM200 billion in 1994. A cover ratio of around 40 percent, corresponding to about DM80 billion in equity capital, is necessary in an international industry comparison. We have around DM35 billion today. We are figuring on a deficit of between DM20 billion and DM30 billion.

[Vogel] According to the latest annual report Telekom for the first time last year had no profit left over. Who at all would buy Telekom stock then?

[Ricke] That is only partly correct. In its operating business Telekom earned a profit of around DM7.2 billion, as in the previous year. However, nothing of this was left over after the statutory handing over to the tune of 10 percent of revenues to the federal government and after deducting the loss compensation for the postal service and postal bank subsidiaries.

[Vogel] Potential Telekom stockholders would not exactly find that lucrative.

[Ricke] Our prospects for the future are all-important to market analysts. Telekom has a healthy core, a strong basis for profitability and a strategically favorable initial position in international business too. Profit on sales of 20 percent in the East and West is a longterm goal. The prospects are also very good.

[Vogel] Under the assumption that fresh capital comes in for investment?

[Ricke] Correct. At present Telekom is being strained very much by the tasks in the new federal lands, where we are presently investing for development of the infrastructure three times as much as we are taking in there in the first place—and this with zero equity capital of the former East German postal service. In the West, too, we need substantial sums in order to speed up the necessary modernization—say, digitalization of the networks. The upshot is that we have to use expensive foreign financing for the majority of our investments. Already today we are paying out more than every tenth mark of revenues for interest on loans.

[Vogel] Can you not tighten the cost screws?

[Ricke] We are doing this too wherever possible. For one thing more competition among suppliers and advances in microelectronics are making purchase prices drop. At the same time we are planning more efficient architectures for our networks. And our research and development will be jointly responsible more strongly than thus far for the efficiency of networks, services and technologies.

[Vogel] The internationalization catchword: Telekom thus far has hardly crossed the borders of Germany. Are you not losing entry into the globalization of telecommunications markets?

[Ricke] We are within the scope of our capabilities in this connection. For example, Telekom is one of the companies of Infonet, which is building and supplying global networks over the entire world. We have founded with France Telecom a joint subsidiary called Eucom, which is marketing international value-added services. Eunetcom is in the process of being founded, in which we will be offering likewise with our French partners global networks for top customers.

[Vogel] And what is the situation in Eastern Europe? There is enormous pent-up demand there.

[Ricke] Indeed, but there is a shortage of money there too. We are already utilizing our know-how gained in the new federal lands, in building a mobile radio network and a dedicated-circuit network in the Ukraine, for example.

[Vogel] Nevertheless your competitors are a couple of steps ahead. They are even acquiring entire networks across their national borders.

[Ricke] For one thing the constitution creates legal doubt as to whether we as a public authority should be active at all abroad. International involvement also costs money. Accordingly the shortage of equity capital is a double burden for us in this respect. In a certain way we are stuck in a dilemma. On the other hand the scanty financial resources could force us to change course.

Development of Mobile Telephone Market in Germany Previewed

93WS0197B Munich TOP-BUSINESS in German Jan 93 Supplement pp 54-57

[Article: "Mobile Millions. Prices Are Nose-Diving, the Competition Is Ruthless and the Potential for Customers Is Enormous. Twenty Million Europeans Are to Be 'Mobilians' by the Turn of the Millennium"]

[Text] Christian Schwarz-Schilling is fond of visions: "By the year 2000 the telecommunications industry will have surpassed by far in importance the automotive industry in

Europe," the postmaster general proclaimed, sure of success, in October at the Telematica industry fair in Stuttgart.

According to him, by that time around 60 percent of all Europeans will have their jobs in companies that make or market telephones, fax machines and satellite equipment (or whatever else facilitates communication between people) or maintains the respective networks.

The industry is to provide 1.3 million jobs then. Seven percent of the combined gross national product of the then United States of Europe will be earned in telecommunications in the year 2000—as the postmaster general sees it in any case.

And Germany is—once again—to assume the trailblazer's role. At least the first digital radio network in the world will be developed here. Yet the Germans at present are still entirely absorbed in the catch-up rush in mobile telephony.

While in Great Britain, North America and even in Scandinavia telephones in cars or handbags have been standard already for years, citizens of the Federal Republic of Germany learned not until less than two years ago that the small cordless sets are a visible "lifestyle" symbol. Whoever at that time could not afford the expensive C-network [cellular radiotelephone network] car phones for 6000 German marks [DM] and more (to be had already by this time for DM4000) souped up their darling at least with dummies for around DM500 in order to be "in."

This will no longer be necessary in the future, thanks to the deregulation of the German telecommunications market instituted in 1989. Now the Federal Postal Service for the first time has to compete in a mass market with a serious competitor, the first private D-network [digital radiotelephone network] operator, Mannesmann Mobilfunk GmbH [Mobile Radio Limited Liability Company].

The marketing of both concomitantly developed digital radio networks through thus far 13 new "service providers" [in English] is to smarten things up even more. These service providers, who will supply on their own account not only connections and terminal devices but also additional services—from breakdown service to finding a hotel and traffic information, have been on the hunt for customers since the middle of the year.

Mannesmann and Telekom want to undersell them with "competitive prices"—and at the same time talk as many customers as possible into mobile telephones. Experts assume that the predominant share of mobile radio customers will be won by the service providers.

The postmaster's general unaccustomed obligingness toward this many-sided competition has economic reasons. For one thing is clear today: Mobile radio will not be a gold mine until it is also used by many people. That is also why the mobile radio experts are raving as unreservedly as possible about the "good transmission quality, the data integrity and the universal applicability of the sets."

As an estimate, the postal service and Mannesmann have already gained 100,000 customers after a half year of operation of their D networks—but there still have to be many more. Telekom and Mannesmann want to lure to their digital networks up to five million customers by the end of the millennium. According to the postmaster's general forecasts a total of 10 million people in Germany are to be reachable at any time—in whatever manner.

Annual revenues of around DM5 billion are expected for the "final phase" of the radio networks. However, for these estimates it is possible thus far to rely only on American experience—the monthly "mobile radio bill" of the average American comes to a good $100 there today.

At least 20 million Europeans will be able to "digital-mobile" telephone one another on New Year's eve of the turn of the millennium. One out of 10 Europeans, the quite optimistic telephone freaks believe, will use mobile communication facilities in the year 2000. Moreover, it will not only be business equipment, but more and more private customers are also to learn to like the advantages of cordless communication.

It is not only Mannesmann and Telekom that the "mobile radio fever" has caught hold of. All that have status and a name in German industry have more or less strongly gotten into the "mass market of the future."

Major concerns of the steel industry, automobile makers, trading firms and energy suppliers want to join in the poker game when it is a question of supplying as many people as possible with car phones or cordless handheld sets with which it is possible to phone anyone in Europe and the world at any time.

Whoever cannot directly be awarded an operator's license wants at least to take part in the business of being a service provider—like Daimler-Benz with its Debitel service subsidiary, for instance.

It sounds tempting—but the time of the big profits is still far off. Colossal investments are necessary first. Just Telekom and Mannesmann Mobilfunk have to invest DM3 billion to DM4 billion each in the development of their "D networks" in order for area-wide coverage to be guaranteed for their mobile radio customers.

Because of the one-year delay of the start of the D network, the break-even point for Mannesmann has been moved still farther ahead. Mobile Radio head Peter Mihatsch does not dare to predict when the 1,400 employees of Germany's first private telephone company will make a positive contribution to the concern's operating result. The Mannesmann manager will only say that "the investments in this market are made for the long term."

The forecasts of the applicant for the next license for cordless telephony, that was promised an award already before the official start of the D networks, are more specific. Hans-Joerg Hafner of Munich car maker BMW estimates the time it will take till a positive result is attained at least eight years from the beginning of "commercial putting into operation."

He has precalculated for his lenders that "the invested capital including the market interest payments will also have flowed back into the till" after 12 years at the earliest. However, experts believe that these investments for the E network will be approximately twice as high as for the D networks.

BMW Manager Hafner has hopes of becoming, at the beginning of the coming year, the head of the second private telephone company, that will develop the "E network" in

Germany. This network is to concentrate primarily on handheld telephones and the development of the digital network in eastern Germany.

The Munich company, together with its neighbor MAN and the American telecommunications specialists US West and GTE, is trying to win the E1 license in the second phase.

The postmaster general will decide by year's end on the bids submitted—and the choice should be easier for him this time than in the big run for the D2 network. While 10 well known consortia applied for the award in 1989, for the E1 it is in the bag for the people in Munich after the most important competitors met there with BMW, MAN, Metallgesellschaft [Metal Corporation] and RWE. Even if no one can predict today who will actually be leading in the mobile communications market at the turn of the millennium, competition is working for the present. Prices slipped even before the first D-network telephones were delivered.

Suppliers like Motorola are already selling their handheld sets dirt cheap at 35 percent off, and mobile telephones for DM1,000 are for experts already the norm for the coming year. "This will produce a tumbling down of prices as in the camcorder market," believes Jens Denecke, head of the telecommunications subsidiary of the PreussenElektra energy group.

At the same time Telekom, Mannesmann, and the service providers have to steadily lower the fees for cordless telephones—quite to the annoyance of Telekom head Helmut Ricke.

Yet the chief executive officer of the postal service's subsidiary thus far can be thoroughly satisfied with the results of private competition. That is to say, the competition for the D network has for the first time increased the attractiveness of the old C network. After several years of a long sleep the German alliance has markedly driven up the number of C-network customers—not least because of the tired-out telephone network in the ex-GDR. The original network capacity of 450,000 subscribers was exceeded long ago. Just under 800,000 citizens of the Federal Republic of Germany presently reach for a C-network telephone. The postal service alone is taking the money here. No wonder then that Postmaster General Schwarz-Schilling and his Telekom governor calmly look forward to the competition. "We have mobile radio authority. Mannesmann first has to prove it," Telekom head Ricke proclaims confidently.

Italy's Telespazio Awarded EUMETSAT Contract

93WS0290A Paris AFP SCIENCES in French 4 Feb 93 p 8

[Text] Paris—The European Organization for the Operation of Weather Satellites (EUMETSAT) has just awarded Italy's Telespazio the contract to build a new reception and tracking station for Meteosat satellites. The organization made the announcement in a communique on 28 January.

The ECU11 million contract covers the installation of new antennas and new data-transmission equipment at Telespazio's already existing site in Fucino, Italy. The station will be linked to a satellite control center that will be built at EUMETSAT's Darmstadt headquarters near Frankfurt between now and the end of 1994. All of the organization's satellites will be controlled from Darmstadt, via Fucino, starting in December 1995. The concept calls for the establishment of other, additional installations elsewhere in Europe in the long term.

EUMETSAT was created in 1986 by 16 European countries. To date, five Meteosat satellites, built under the supervision of Aerospatiale as chief contractor, have been placed into orbit for the organization's use. The sixth is being built in Cannes and is scheduled to be launched by an Ariane rocket next November. The Meteosat transition program (MTP) plans a seventh satellite, to prevent any interruption in service between late 1995 and the start of service of the second generation of Meteosat satellites. It is expected to be launched early, in late 1995 or early 1996.

Philips Suspends HD-MAC TV Production

93WS0290B Paris AFP SCIENCES in French 4 Feb 93 p 12

[Text] La Haye—Philips has decided to suspend production of HD-MAC high-definition television sets for the time being, until programs in HDTV become available. The president of the group's Consumer Electronics division, Henk Bodt, made the announcement in an interview with the Dutch daily HET FINANCIEELE DAGBLAD that was published 30 January.

"Until Europe makes a policy decision on whether or not to go through with the plan of action[1], we cannot justify starting up a production line for HD-MAC sets," said Mr. Bodt. "So we are taking some of our staff who have worked on the project off it."

According to Mr. Bodt, Philips is not responsible for the delay in introducing HDTV in Europe. "The technique is ready. The system is complete and it is a perfect system" that Philips will present at the Berlin Electronics Show.

Footnotes

1. The plan, which has been allocated ECU500 million, is supposed to stimulate the production of programs in HDTV.

Dutch PTT Considers Fiber-Optic 'Broadband Video Net'

93BR0390 Amsterdam COMPUTABLE in Dutch 29 Jan 93 p 9

[Article: "PTT Telecom In Fiber-Optic Network After All"]

[Text] The Hague—PTT Telecom is carrying out investigations into whether cable companies are interested in the broadband video network (BVN) which PTT Telecom intends to install for radio and television signals. Proposals for this have been submitted to the Association for Cable Operators and License Holders (VECAI).

A part of the PTT's backbone network [aansluitnet] will be "glassified" for the benefit of the video network. This plan fits into the master plan which is being developed by the PTT. Last week spokeswoman M. Plaschek denied that PTT Telecom intended to invest many billions in 100,000 kilometers of fiber-optic cables. From a reaction to this given by spokesman B. de Vos, however, it appears that the PTT does

have serious plans to invest billions in fiber-optics over a long period. Between 1993 and 2002 the backbone network in 128 local authority areas with more than 10,000 inhabitants will be fitted with glass fiber. A part of this—for several hundred million guilders—will be attributed to the broadband video network which PTT Telecom now wants to set up.

The video network will operate for a large part on the existing infrastructure. With the development of the network, the PTT hopes to anticipate the wishes of the cable companies. "The owners of large regional and city networks will have to make large investments in their infrastructures in order to be able to receive and deliver cable signals," said PTT Telecom.

The new service will be offered, according to the PTT, "in open competition with other bidders." The broadband video network must be completely operational by the end of 1994.

SCIENCE & TECHNOLOGY POLICY

Brazil: Plans for Centralized Research Database

93WS0330A Sao Paulo GAZETA MERCANTIL in Portuguese 12 Feb 93 p 9

[Article by Mariluce Moura: "Databank To Reveal Brazilian Scientific Research Topics"]

[Text] Sao Paulo—Brazil is not informed on the research topics that have activated its scientists during recent years, much less on whether these topics are meeting the national productive sector's demands. There are scattered, vague data on this subject, such as the report from the Ministry of Science and Technology to the effect that over 60 percent of Brazilian research is concentrated on the biological sciences. And there is some idea regarding fields in which the country has gained competence, such as that of genetic improvement. However, there are no up-to-date, overall statistics on its scientific and technical research; furthermore, they have never existed.

That basic shortcoming in the so-called national scientific and technical development system is what the Brazilian Association of Technological and Industrial Research Institutions (ABIPTI), with headquarters in Brasilia, has decided to attack. It is doing so in a survey, already begun, intended to compile a computerized database in which the most important study topics, and also the researchers operating in Brazil, will be classified.

The project coordinator, and ABIPTI's assistant director, Ivan Rocha, remarks: "We shall have the research topics classified according to their economic, social, or strategic significance." The survey will make no distinction between basic and applied research, and will use a classification oriented mainly "toward the use that the society, and hence the economic sectors as well, will be able to make of the research results," notes Rocha.

That orientation will cause highly speculative studies in the human sciences areas to be kept out of the database, which has already been given a rather pompous name: "competence matrix of the national scientific-technical base."

Information From the Development Agencies

ABIPTI is a non-governmental institution, supported by 40 entities that have connections with the productive sector, such as SENAI [National Service for Industrial Apprenticeship], EMBRAPA [Brazilian Agricultural and Livestock Research Enterprise], the National Institute of Space Research (INPE), and the Leather and Footwear Institute of Novo Hamburgo.

In its concern for obtaining more reliable data on research in Brazil to offer to the productive sector, the association has maintained contacts with the Strategic Affairs Secretariat (SAE), which had for some time evinced an interest in the problem.

Rocha observes: "However, the SAE lost interest and, on its own initiative, during the second half of last year, ABIPTI approved the plan to create a technological information center." In fact, it was the formation of that center that was being initiated with the collection of competence matrix data beginning in late 1992.

That matrix, in the opinion of Ivan Rocha, who is also an engineer and researcher in the Scientific and Technical Policy Center at Brasilia University (UNB), should greatly facilitate the "wedding" of research centers with users in the productive sector. He claims that this will be achieved at a low cost (which he does not explain for the present), since it was not based on a direct survey among the researchers, but rather on the organization of data from development agencies, prorectors' offices at Brazilian universities, and autonomous research institutes in business firms.

Rocha comments: "It should be stressed that reasons of cost were not the only ones for our choice of an indirect survey. We had to learn exactly what is being researched, and not what the researcher would like to investigate." He claims that, "As a result, the information from the agencies financing the studies, such as the National Scientific and Technical Development Council (CNPQ), is far more accurate, more clearly reflecting the real picture."

From the end of last year to the present, ABIPTI classified nearly 4,000 topics and, at that point, anticipated that it would cover the total universe of scientific and technical research with 12,000 topics. The first classification work on all this is due to be completed within approximately three months.

For the time being, Rocha deems it too early to estimate the fields in which Brazil has more critical mass, and which topics, although "loudly heralded," have been the subject of overly sporadic study. He remarks: "It is evident that much work is still being done on genetic improvement, as was already known, but the amount of work under way in the field of dynamic systems in physics and mathematics is amazing. Hence, it would be too risky to draw any conclusions at present."

The ABIPTI database, besides classifying topics, will have a second breakdown, by type of institution. The project coordinator explains: "We are mapping research in universities, research institutions, business firms, and other government organs."

EUROPE-ASIA RELATIONS

France, Pakistan Sign Nuclear Agreement

93WS0312B Paris AFP SCIENCES in French 11 Feb 93 pp 26-27

[Unattributed article: "Civil Nuclear Cooperation Agreement Between Pakistan and France Concluded"]

[Text] Islamabad—On 9 February, in Islamabad, France and Pakistan concluded a scientific agreement on civil nuclear cooperation in agriculture, medicine, and the environment, we learned from a diplomatic source.

The agreement was concluded through an exchange of letters between the general secretary of the Pakistani Ministry of Foreign Affairs, Mr. Akram Zaki, and the French ambassador to Pakistan, Mr. Jean-Pierre Masset, in the presence of the French minister delegate to foreign affairs, Mr. Georges Kiejman, who is currently on a four-day official visit to Pakistan. "This agreement is purely scientific, and is not related in any way to the nuclear power-plant issue," the French embassy indicated in a communique.

During President Francois Mitterrand's visit to Islamabad, in February 1990, France had promised to deliver a 900-megawatt civil power plant to Pakistan; later on, it put political conditions on the sale: Pakistan was to sign the Nuclear Non-Proliferation Treaty (TNP) and to accept "integral control" of its nuclear facilities. Pakistan said it was prepared to comply with these conditions as soon as India will do the same.

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, military, economic, environmental, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available sources. It should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated; those from English-language sources are transcribed. Except for excluding certain diacritics, FBIS renders personal names and place-names in accordance with the romanization systems approved for U.S. Government publications by the U.S. Board of Geographic Names.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names rendered phonetically are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source. Passages in boldface or italics are as published.

SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in eight volumes: China, East Europe, Central Eurasia, East Asia, Near East & South Asia, Sub-Saharan Africa, Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications, which include approximately 50 regional, worldwide, and topical reports, generally contain less time-sensitive information and are published periodically.

Current DAILY REPORTs and JPRS publications are listed in *Government Reports Announcements* issued semimonthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. New subscribers should expect a 30-day delay in receipt of the first issue.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcover or microfiche) at no charge through their sponsoring organizations. For additional information or assistance, call FBIS, (202) 338-6735,or write to P.O. Box 2604, Washington, D.C. 20013. Department of Defense consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.)

Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.